MAINE TURNPIKE AUTHORITY

MAINE TURNPIKE

CONTRACT DOCUMENTS

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

NOTICE TO CONTRACTORS

PROPOSAL

CONTRACT AGREEMENT

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SPECIFICATIONS

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

The Specifications are divided into two parts:
Part I, Supplemental Specifications and Part II, Special Provisions.

The Maine Turnpike Supplemental Specifications are additions and alterations to the 2014 Maine Department of Transportation Standard Specifications. See Subsection 100.1.

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MAINE TURNPIKE AUTHORITY

NOTICE TO CONTRACTORS

Sealed Proposals will be received by the Maine Turnpike Authority for:

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

at the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, ME, until 11:00 a.m., prevailing time as determined by the Authority on November 8, 2022 at which time and place the Proposals will be publicly opened and read. Bids will be accepted from Contractors **prequalified** by the Maine Department of Transportation for Highway Construction Projects or Bridge Construction Projects. In addition, Contractors submitting bids must be themselves or utilize a highway subcontractor **prequalified** by the Maine Department of Transportation, a bridge subcontractor **prequalified** by the Maine Department of Transportation, a building subcontractor **prequalified** by the Maine Department of Transportation for Buildings, and an electrical subcontractor **prequalified** by the Maine Department of Transportation for Traffic Signals and Lighting Projects. All other bids may be rejected. This Project includes a wage determination developed by the State of Maine Department of Labor.

The work consists of highway, interchange, and toll system construction at Exit 35 in Saco and modifications to the Exit 36 Interchange in Saco. The work includes a new interchange at MM 35, including southbound and northbound ramps, a new southbound toll plaza on the west side of the Maine Turnpike with a signalized intersection at Route 112, a new northbound toll plaza on the east side of the Maine Turnpike with a signalized intersection at Route 112, widening of the southbound Maine Turnpike to construct a separated collector-distributor road, widening of Route 112, and construction of access roads. The work includes earthwork, pavement, concrete, signing, overhead sign structures, concrete barrier, guardrail, drainage, stormwater management, electrical work, highway lighting, lightning suppression systems, and maintenance of traffic. The toll plaza work includes installation of tolling equipment, administration buildings, canopies, and toll booths and all other work incidental thereto in accordance with the Plans and Specifications.

Plans and Contract Documents may be examined by prospective Bidders weekdays between 8:00 a.m. and 4:30 p.m. at the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, Maine. **The half size Plans** and Contract Documents may be obtained from the Authority upon payment of Two Hundred Fifty ($250.00) Dollars for each set, which payment will not be returned. Checks shall be made payable to: Maine Turnpike Authority. The Plans and Contract Documents may also be downloaded from a link on our website at http://www.maineturnpike.com/project-and-planning/Construction-Contracts.aspx.

For general information regarding Bidding and Contracting procedures, contact Nate Carll, Purchasing Manager, at (207) 482-8115. For information regarding Schedule of Items, plan holders

list and bid results, visit our website at **http://www.maineturnpike.com/project-and-planning/Construction-Contracts.aspx** . For Project specific information, fax all questions to Nate Carll, Purchasing Manager, at (207) 871-7739 or email ncarll@maineturnpike.com. Responses will not be prepared for questions received by telephone. Bidders shall not contact any other Authority staff or Consultants for clarification of Contract provisions, and the Authority will not be responsible for any interpretations so obtained.

All work shall be governed by the Specifications entitled "State of Maine, Department of Transportation, Standard Specifications, Revision of November 2014", "Standard Details" latest revision and "Best Management Practices for Erosion and Sediment Control", latest issue. Copies and recent updates to these publications can be downloaded at: http://www.maine.gov/mdot/contractors/publications/ .

Proposals must be accompanied by an original bid bond, certified or cashier's check payable to the Maine Turnpike Authority in an amount not less than Five (5%) Percent of the Total Amount in the Proposal, but not less than $500.00. The Bidder to whom a Contract is awarded will be required to furnish a Surety Corporation Bond, satisfactory to the Authority, on the standard Contract Bond form of the Authority, for a sum not less than the Total Amount of the Proposal.

Proposals must be made upon the Proposal Forms furnished by the Authority separately with the Contract Documents, and must be enclosed in the sealed special addressed envelope provided therefore bearing the name and address of the Bidder, the name of the Contract, and the date and time of Proposal opening on the outside.

A pre-bid conference will be held on October 25, 2022 at 10:00 a.m. at the Maine Turnpike Authority, 2360 Congress Street, Portland, Maine.

The Authority reserves the unqualified right to reject any or all Proposals and to accept that Proposal which in its sole judgment will under all circumstances serve its best interest.

MAINE TURNPIKE AUTHORITY

Nate Carll
Purchasing Manager
Maine Turnpike Authority

Portland, Maine

Maine Turnpike Authority

MAINE TURNPIKE

PROPOSAL

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

MAINE TURNPIKE AUTHORITY

PROPOSAL

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

TO MAINE TURNPIKE AUTHORITY:

The work consists of highway, interchange, and toll system construction at Exit 35 in Saco and modifications to the Exit 36 Interchange in Saco. The work includes a new interchange at MM 35, including southbound and northbound ramps, a new southbound toll plaza on the west side of the Maine Turnpike with a signalized intersection at Route 112, a new northbound toll plaza on the east side of the Maine Turnpike with a signalized intersection at Route 112, widening of the southbound Maine Turnpike to construct a separated collector-distributor road, widening of Route 112, and construction of access roads. The work includes earthwork, pavement, concrete, signing, overhead sign structures, concrete barrier, guardrail, drainage, stormwater management, electrical work, highway lighting, lightning suppression systems, and maintenance of traffic. The toll plaza work includes installation of tolling equipment, administration buildings, canopies, and toll booths and all other work incidental thereto in accordance with the Plans and Specifications.

This Work will be done under a Contract known as Contract 2022.07 according to the Plans and Specifications which are on file in the office of the Maine Turnpike Authority, 2360 Congress Street, Portland, Maine.

On the acceptance of this Proposal for said Work, the undersigned will give the required bond with good security conditioned for the faithful performance of said Work, according to said Plans and Specifications, and the doing of all other work required by said Specifications for the consideration herein named and with the further condition that the Maine Turnpike Authority shall be saved harmless from any and all damages that might accrue to any person, persons or property by reason of the carrying out of said Work, or any part thereof, or by reason of negligence of the undersigned, or any person or persons under his employment and engaged in said Work.

The undersigned hereby declares that he/she has carefully examined the Plans, Specifications and other Contract Documents, and that he/she will contract to carry out and complete the said Work as specified and delineated at the price per unit of measure for each scheduled item of Work stated in the Schedule of Prices as follows:

It is understood that the TOTAL AMOUNT stated by the undersigned in the following Schedule of Prices is based on approximate quantities and will be used solely for the comparison of bids, and that the quantities stated in the Schedule of Prices for the various items are estimates only and may be increased or decreased all as provided in the Specifications.

SCHEDULE OF BID PRICES
CONTRACT NO. 2022.07
Interchange Improvements
Saco (Exits 35 & 36)
MM 34.7 to MM 36.6

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
201.11	CLEARING	Acre	6				
201.23	REMOVING SINGLE TREE TOP ONLY	Each	26				
201.24	REMOVING STUMP	Each	15				
202.08	REMOVING BUILDING NO. 1	Lump Sum	1				
202.12	REMOVING EXISTING STRUCTURAL CONCRETE	Cubic Yard	10				
202.15	REMOVING EXISTING MANHOLE OR CATCH BASIN	Each	20				
202.202	REMOVING PAVEMENT SURFACE	Square Yard	18,850				
202.205	RUMBLE STRIPS	Each	18,100				
202.206	REMOVING RUMBLE STRIPS	Linear Foot	18,100				
203.20	COMMON EXCAVATION	Cubic Yard	120,600				
203.21	ROCK EXCAVATION	Cubic Yard	1,800				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
203.2312	HEALTH AND SAFETY PLAN (HASP)	Lump Sum	1				
203.2319	MEDIA MANAGEMENT PLAN (EMMP)	Lump Sum	1				
203.2333	DISPOSAL/TREATMENT OF SPECIAL EXCAVATION	Ton	540				
203.2334	DISPOSAL/TREATMENT OF GROUNDWATER	Gallon	105,000				
203.25	GRANULAR BORROW	Cubic Yard	21,150				
203.33	SPECIAL FILL - STREAMBED MATERIAL	Cubic Yard	20				
203.52	LOW PERMEABILITY FILL	Cubic Yard	300				
206.082	STRUCTURAL EARTH EXCAVATION - MAJOR STRUCTURES, PLAN QUANTITY	Cubic Yard	610				
209.29	PREFABRICATED VERTICAL DRAINS	Linear Foot	85,800				
304.10	AGGREGATE SUBBASE COURSE - GRAVEL	Cubic Yard	40,050				
304.14	AGGREGATE BASE COURSE - TYPE A	Cubic Yard	23,200				
403.207	HOT MIX ASPHALT, 19.0 mm NOMINAL MAXIMUM SIZE	Ton	7,900				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
403.2072	19.0 mm ASPHALT RICH BASE HMA	Ton	7,750				
403.208	HOT MIX ASPHALT, 12.5 mm	Ton	1,710				
403.2081	HOT MIX ASPHALT, 12.5 mm (POLYMER MODIFIED) - RAP	Ton	7,300				
403.209	HOT MIX ASPHALT, 9.5 mm NOMINAL MAXIMUM SIZE (SIDEWALKS, DRIVES, ISLANDS & INCIDENTALS)	Ton	382				
403.211	HOT MIX ASPHALT, 9.5 mm NOMINAL MAXIMUM SIZE (SHIMMING)	Ton	200				
403.213	HOT MIX ASPHALT, 12.5 mm NOMINAL MAXIMUM SIZE (BASE AND INTERMEDIATE BASE COURSE)	Ton	9,010				
409.15	BITUMINOUS TACK COAT RS-1 OR RS1H - APPLIED	Gallon	8,450				
409.152	BITUMINOUS TACK COAT NTSS - 1HM TRACKLESS - APPLIED	Gallon	6,240				
419.30	SAWING BITUMINOUS PAVEMENT	Linear Foot	16,000				
424.323	ASHPALT RUBBER MASTIC CRACK SEALER - APPLIED	Pound	1,890				
470.08	BERM DROPOFF CORRECTION - GRINDINGS	Ton	440				
501.231	DYNAMIC LOAD TEST	Each	4				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
501.54	STEEL H-BEAM PILES 117 LB/FT, DELIVERED	Linear Foot	2,500				
501.541	STEEL H-BEAM PILES 117 LB/FT, IN PLACE	Linear Foot	2,500				
501.90	PILE TIPS	Each	44				
501.91	PILE SPLICES	Each	38				
501.92	PILE DRIVING EQUIPMENT MOBILIZATION	Lump Sum	1				
502.21	STRUCTURAL CONCRETE, ABUTMENTS AND RETAINING WALLS	Cubic Yard	10				
502.262	STRUCTURAL CONCRETE, PAVEMENT SLABS (659 CY)	Lump Sum	1				
502.263	STRUCTURAL CONCRETE, PLAZA ISLANDS, BUMPERS, AND CURTAIN WALLS (124 CY)	Lump Sum	1				
502.264	STRUCTURAL CONCRETE, PILE CAPS (148 CY)	Lump Sum	1				
502.265	STRUCTURAL CONCRETE, UTILITY PITS (79 CY)	Lump Sum	1				
502.266	STRUCTURAL CONCRETE, PEDESTALS AND FOOTINGS (18 CY)	Lump Sum	1				
502.701	BRIDGE DRAIN DOWNSPOUT EXTENSION	Each	4				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
502.7011	WEEP DRAIN EXTENSIONS	Lump Sum	1				
503.14	EPOXY-COATED REINFORCING STEEL, FABRICATED AND DELIVERED	Pound	132,000				
503.15	EPOXY-COATED REINFORCING STEEL, PLACING	Pound	132,000				
503.18	GLASS FIBER REINFORCED POLYMER (GFRP) REINFORCING BARS, FABRICATED AND DELIVERED	Linear Foot	85,300				
503.19	GLASS FIBER REINFORCED POLYMER (GFRP) REINFORCING BARS, PLACING	Linear Foot	85,300				
503.90	SYNTHETIC FIBER REINFORCEMENT	Pound	2,000				
504.50	TOLL PLAZA CANOPY - NORTHBOUND	Lump Sum	1				
504.51	TOLL PLAZA CANOPY - SOUTHBOUND	Lump Sum	1				
504.61	TOLL GANTRY - NORTHBOUND	Lump Sum	1				
504.62	TOLL DUAL PURPOSE MAST ARM - SOUTHBOUND	Lump Sum	1				
506.142	FIELD PAINTING OF EXISTING STRUCTURAL STEEL	Lump Sum	1				
508.14	HIGH PERFORMANCE WATERPROOFING MEMBRANE	Lump Sum	1				
			CARRIED FORWARD:				

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
511.071	COFFERDAM - GOOSEFARE BROOK	Lump Sum	1				
513.09	SLOPE PROTECTION - PORTLAND CEMENT CONCRETE	Square Yard	36				
514.06	CURING BOX FOR CONCRETE CYLINDERS	Each	1				
515.201	PIGMENTED PROTECTIVE COATING FOR CONCRETE SURFACES	Square Yard	610				
515.202	CLEAR PROTECTIVE COATING FOR CONCRETE SURFACES	Square Yard	1,100				
515.203	BROADCAST SEALANT FOR CONCRETE SURFACES	Square Yard	910				
515.23	EPOXY OVERLAY	Square Yard	86				
518.10	ABUTMENT REPAIRS	Square Foot	20				
518.39	GRANITE CURB JOINT MORTAR AND BEDDING MORTAR REPAIR	Linear Foot	400				
518.40	EPOXY INJECTION CRACK REPAIR	Linear Foot	5				
518.43	PARAPET JOINT REPAIR	Linear Foot	100				
518.50	REPAIR OF UPWARD FACING SURFACES - TO REINFORCING STEEL < 8 INCHES	Square Foot	5				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
518.60	REPAIR OF VERTICAL SURFACES < 8 INCHES	Square Foot	5				
518.80	PARTIAL DEPTH CONCRETE DECK REPAIRS	Square Foot	100				
518.864	ELASTOMERIC CONCRETE HEADER REPAIR	Cubic Foot	24				
520.231	EXPANSION DEVICE - ASPHALTIC PLUG JOINT FOR CRACK CONTROL	Linear Foot	180				
526.301	TEMPORARY CONCRETE BARRIER, TYPE I	Linear Foot	5,000				
526.306	TEMPORARY CONCRETE BARRIER, TYPE I - SUPPLIED BY AUTHORITY	Lump Sum	1				
526.307	CONCRETE BARRIER TYPE I - STORMWATER FILTER	Linear Foot	90				
526.351	CONCRETE BARRIER - TYPE A	Lump Sum	1				
526.368	CONCRETE BARRIER - TYPE C GUARDRAIL TRANSITION BARRIER	Each	2				
527.307	CENTER BARRIER CRASH ATTENUATOR (SMART CUSHION)	Each	2				
527.341	WORK ZONE CRASH CUSHION - TL-3	Unit	7				
527.342	WORK ZONE CRASH CUSHION - TL-2	Unit	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
602.40	PUMPED GROUT FILL	Cubic Yard	12				
603.151	12 INCH CORRUGATED METAL PIPE	Linear Foot	6				
603.155	12 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	230				
603.1553	12 INCH REINFORCED CONCRETE PIPE - CLASS V	Linear Foot	55				
603.159	12 INCH CULVERT PIPE OPTION III	Linear Foot	740				
603.165	15 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	40				
603.1653	15 INCH REINFORCED CONCRETE PIPE - CLASS V	Linear Foot	3				
603.169	15 INCH CULVERT PIPE OPTION III	Linear Foot	77				
603.175	18 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	280				
603.1753	18 INCH REINFORCED CONCRETE PIPE - CLASS V	Linear Foot	190				
603.179	18 INCH CULVERT PIPE OPTION III	Linear Foot	20				
603.195	24 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	140				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
603.2053	30 INCH REINFORCED CONCRETE PIPE - CLASS V	Linear Foot	52				
603.215	36 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	170				
603.2153	36 INCH REINFRORCED CONCRETE PIPE - CLASS V	Linear Foot	150				
603.235	48 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	34				
603.245	54 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	44				
603.28	CONCRETE COLLAR	Each	12				
603.285	84 INCH REINFORCED CONCRETE PIPE - CLASS III	Linear Foot	26				
604.073	CATCH BASIN TYPE A1	Each	3				
604.09	CATCH BASIN TYPE B1	Each	5				
604.092	CATCH BASIN TYPE B1-C	Each	22				
604.096	60" CATCH BASIN TYPE B1-C	Each	2				
604.15	MANHOLE	Each	2				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
604.16	ALTERING CATCH BASIN TO MANHOLE	Each	1				
604.18	ADJUSTING MANHOLE OR CATCH BASIN TO GRADE	Each	7				
604.182	CLEANING EXISTING CATCH BASIN AND MANHOLE	Each	30				
604.246	CATCH BASIN TYPE F5	Each	12				
604.248	CATCH BASIN TYPE F6	Each	22				
604.249	CATCH BASIN TYPE F6-C	Each	2				
604.25	CATCH BASIN TYPE A5	Each	1				
604.26	CATCH BASIN TYPE B5	Each	28				
604.262	CATCH BASIN TYPE B5-C	Each	4				
604.263	60" CATCH BASIN TYPE B5	Each	2				
604.40	SECURE CATCH BASIN GRATE	Each	11				
605.016	6" PVC UNDERDRAIN	Linear Foot	2,600				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
605.018	8" PVC UNDERDRAIN	Linear Foot	820				
605.09	6 INCH UNDERDRAIN TYPE B	Linear Foot	2,180				
605.11	12 INCH UNDERDRAIN TYPE C	Linear Foot	3,739				
605.12	15 INCH UNDERDRAIN TYPE C	Linear Foot	1,870				
605.13	18 INCH UNDERDRAIN TYPE C	Linear Foot	1,250				
605.15	24 INCH UNDERDRAIN TYPE C	Linear Foot	406				
606.1301	31" W-BEAM GUARDRAIL - MID-WAY SPLICE (7' STEEL POSTS, 8" OFFSET BLOCKS, SINGLE FACED)	Linear Foot	6,900				
606.1303	31" W-BEAM GUARDRAIL - MID-WAY SPLICE - 15' RADIUS & LESS	Linear Foot	38				
606.1304	31" W-BEAM GUARDRAIL - MID-WAY SPLICE - OVER 15' RADIUS	Linear Foot	150				
606.1307	31" W-BEAM GUARDRAIL - MID-WAY SPLICE FLARED TERMINAL	Each	17				
606.132	31" W-BEAM GUARDRAIL - MID-WAY SPLICE (7' STEEL POSTS, 8" OFFSET BLOCKS, DOUBLE FACED)	Linear Foot	3,700				
606.1351	31" W-BEAM GUARDRAIL - MID-WAY SPLICE TERMINAL END - ANCHORED END	Each	15				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
606.1352	31" W-BEAM GUARDRAIL - MID-WAY SPLICE TERMINAL END - ANCHORED END, DOUBLE FACED	Each	1				
606.1723	BRIDGE TRANSITION - TYPE III	Each	6				
606.265	TERMINAL END - SINGLE RAIL - GALVANIZED STEEL	Each	6				
606.279	TERMINAL END - ANCHORED END, THRIE BEAM	Each	2				
606.352	REFLECTORIZED BEAM GUARDRAIL DELINEATOR	Each	190				
606.353	REFLECTORIZED FLEXIBLE GUARDRAIL MARKER	Each	50				
606.356	UNDERDRAIN DELINEATOR POST	Each	105				
606.3561	DELINEATOR POST - REMOVE AND RESET	Each	293				
606.36	GUARDRAIL - REMOVE AND RESET	Linear Foot	50				
606.47	SINGLE WOOD POST	Each	6				
606.51	MULTIPLE MAILBOX SUPPORT	Each	1				
606.64	GUARDRAIL THRIE BEAM - DOUBLE RAIL	Linear Foot	430				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
606.65	GUARDRAIL THRIE BEAM - SINGLE RAIL	Linear Foot	88				
606.701	ASYMMETRICAL THRIE BEAM TRANSITION	Each	3				
606.83	GUARDRAIL - REMOVE AND RESET EXISITNG CRASH END	Each	1				
607.09	WOVEN WIRE FENCE - METAL POSTS	Linear Foot	2,100				
607.32	BRACING ASSEMBLY TYPE 1 - METAL POSTS	Each	2				
607.33	BRACING ASSEMBLY TYPE II - METAL POSTS	Each	25				
607.45	STOCKADE FENCE - 6' TALL	Linear Foot	140				
608.08	REINFORCED CONCRETE SIDEWALK	Square Yard	210				
608.26	CURB RAMP DETECTABLE WARNING FIELD	Square Foot	240				
609.11	VERTICAL CURB TYPE 1	Linear Foot	390				
609.12	VERTICAL CURB TYPE 1 - CIRCULAR	Linear Foot	130				
609.13	VERTICAL BRIDGE CURB TYPE 1	Linear Foot	520				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
609.14	VERTICAL BRIDGE CURB TYPE 1 - CIRCULAR	Linear Foot	180				
609.15	SLOPED CURB TYPE 1	Linear Foot	16				
609.21	CONCRETE SLIPFORM CURB	Linear Foot	2,690				
609.219	CONCRETE SLIPFORM CURB - TERMINAL END	Linear Foot	256				
609.221	TERMINAL CURB TYPE 1	Linear Foot	95				
609.222	TERMINAL CURB TYPE 1 - CIRCULAR	Linear Foot	12				
609.34	CURB TYPE 5	Linear Foot	1,450				
609.35	CURB TYPE 5 - CIRCULAR	Linear Foot	53				
610.08	PLAIN RIPRAP	Cubic Yard	816				
610.18	STONE DITCH PROTECTION	Cubic Yard	72				
610.181	TEMPORARY STONE CHECK DAM	Cubic Yard	510				
610.213	VOID-FILLED RIPRAP - TYPE A OR B	Cubic Yard	120				
			CARRIED FORWARD:				

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
613.319	EROSION CONTROL BLANKET	Square Yard	37,000				
615.07	LOAM	Cubic Yard	5,720				
618.13	SEEDING METHOD NUMBER 1	Unit	77				
618.14	SEEDING METHOD NUMBER 2	Unit	779				
618.143	SPECIAL SEEDING	Unit	3				
618.15	TEMPORARY SEEDING	Pound	9				
619.1201	MULCH - PLAN QUANTITY	Unit	859				
619.1202	TEMPORARY MULCH	Lump Sum	1				
619.1401	EROSION CONTROL MIX	Cubic Yard	100				
620.56	DRAINAGE GEOTEXTILE	Square Yard	10,900				
620.561	IMPERVIOUS LINER	Square Yard	5,200				
620.58	EROSION CONTROL GEOTEXTILE	Square Yard	3,645				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
621.046	EVERGREEN TREE (8 - 10 FEET) GROUP A	Each	13				
621.264	MULTI-STEM DECIDUOUS TREE GROUP A	Each	2				
621.273	LARGE DECIDUOUS TREE (2" - 2.5" CALIPER) GROUP A	Each	15				
621.389	EVERGREENS (15" - 18") GROUP A	Each	6				
621.401	EVERGREENS (2 - 2.5 FEET) GROUP A	Each	4				
621.513	HYBRID RHODODENDRON (2.5 - 3 FEET)	Each	5				
621.552	DECIDUOUS SHRUBS (3 - 4 FEET) GROUP A	Each	60				
625.106	WATER SERVICE SUPPLY LINE (<3 IN)	Linear Foot	750				
625.107	WATER METER PIT	Each	2				
626.121	QUAZITE JUNCTION BOX (36X24)	Each	15				
626.122	QUAZITE JUNCTION BOX (18X11)	Each	143				
626.123	QUAZITE JUNCTION BOX (48X36)	Each	4				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
626.13	4' X 6' SPLICE BOX WITH ACCESS DOOR	Each	5				
626.22	NON-METALLIC CONDUIT	Linear Foot	37,700				
626.223	HORIZONTAL DIRECTIONAL DRILLED CONDUIT	Linear Foot	1,900				
626.31	18 INCH DIAMETER FOUNDATION	Each	15				
626.32	24 INCH DIAMETER FOUNDATION	Each	127				
626.33	30 INCH DIAMETER, LESS THAN 8 FEET OR LESS FOUNDATION	Each	4				
626.332	30-INCH DIAMETER, GREATER THAN 8-FEET LONG, ALL 36 INCH AND 42 INCH DIAMETER FOUNDATIONS	Cubic Yard	113				
626.333	48-INCH DIAMETER, 54-INCH DIAMETER, 60-INCH DIAMETER FOUNDATIONS	Cubic Yard	25				
626.35	CONTROLLER CABINET FOUNDATION	Each	4				
626.36	REMOVE OR MODIFY CONCRETE FOUNDATION	Each	39				
626.38	GROUND MOUNTED CABINET FOUNDATION	Each	1				
627.18	12" SOLID WHITE PAVEMENT MARKING LINE	Linear Foot	7,500				
			CARRIED FORWARD:				

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
627.712	WHITE OR YELLOW PAVEMENT MARKING LINE	Linear Foot	120,650				
627.73	TEMPORARY 6 INCH PAVEMENT MARKING TAPE	Linear Foot	67,200				
627.731	TEMPORARY 6 INCH BLACK PAVEMENT MARKING TAPE	Linear Foot	1,400				
627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	Linear Foot	460				
627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	Square Foot	3,100				
627.77	REMOVING EXISTING PAVEMENT MARKING	Square Foot	20,400				
627.78	TEMPORARY PAVEMENT MARKING LINE, WHITE OR YELLOW	Linear Foot	197,000				
627.812	TEMPORARY RAISED PAVEMENT MARKERS	Each	7,050				
627.941	PAVEMENT MARKING TAPE – DOTTED WHITE LANE LINE, 6-INCH WIDTH	Linear Foot	670				
627.942	PAVEMENT MARKING TAPE – DOTTED WHITE LANE LINE, 12-INCH WIDTH	Linear Foot	860				
627.944	PAVEMENT MARKING - RECESSED TAPE - WORDS, ARROWS, STOP BARS	Square Foot	360				
629.05	HAND LABOR, STRAIGHT TIME	Hour	200				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
631.10	AIR COMPRESSOR (INCLUDING OPERATOR)	Hour	70				
631.11	AIR TOOL (INCLUDING OPERATOR)	Hour	70				
631.12	ALL PURPOSE EXCAVATOR (INCLUDING OPERATOR)	Hour	200				
631.13	BULLDOZER (INCLUDING OPERATOR)	Hour	200				
631.14	GRADER (INCLUDING OPERATOR)	Hour	100				
631.171	TRUCK - SMALL (INCLUDING OPERATOR)	Hour	100				
631.172	TRUCK - LARGE (INCLUDING OPERATOR)	Hour	100				
631.18	CHAIN SAW RENTAL (INCLUDING OPERATOR)	Hour	30				
631.21	ROAD BROOM (INCLUDING OPERATORS AND HAULER)	Hour	10				
631.22	FRONT END LOADER (INCLUDING OPERATOR)	Hour	100				
631.32	CULVERT CLEANER (INCLUDING OPERATOR)	Hour	50				
631.36	FOREMAN	Hour	100				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
631.51	BUCKET TRUCK	Hour	60				
631.52	SCISSOR LIFT	Hour	60				
631.53	ELECTRICIAN	Hour	100				
631.54	ELECTRICIAN'S APPRENTICE	Hour	100				
631.55	PLUMBER	Hour	60				
633.031	NATURAL GAS SERVICE - NORTHBOUND	Lump Sum	1				
633.0311	NATURAL GAS SERVICE - HOTEL	Lump Sum	1				
633.032	PROPANE SERVICE - SOUTHBOUND	Lump Sum	1				
633.21	PROPANE TANK SUPPORTS (12' X 4')	Each	2				
633.31	PROPANE TANK PAD	Square Yard	27				
634.052	REMOVE HIGH MAST LIGHT STANDARD	Each	3				
634.1751	REPLACEMENT LED FIXTURE - SUPPLIED BY THE AUTHORITY	Each	12				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
634.2078	HIGH MAST LIGHT STANDARD - SUPPLIED BY THE AUTHORITY	Each	1				
634.208	REMOVE AND RESET LIGHT STANDARD	Each	8				
634.2312	CONVENTIONAL LIGHT STANDARD WITH LED FIXTURE - SUPPLIED BY THE AUTHORITY	Each	80				
636.400	SOIL NAIL WALL DESIGN	Lump Sum	1				
636.401	SOIL NAIL WALL CONSTRUCTION MONITORING - EXISTING BRIDGE	Lump Sum	1				
636.411	SOIL NAIL WALL	Square Foot	3,750				
639.26	INSTRUMENTATION (GEOTECHNICAL)	Lump Sum	1				
643.712	LANE USE SIGNAL	Each	6				
643.713	PREEMPTIVE SYSTEM AT EXIT 35 NB INTERSECTION	Lump Sum	1				
643.714	PREEMPTIVE SYSTEM AT EXIT 35 SB INTERSECTION	Lump Sum	1				
643.80	TRAFFIC SIGNAL AT ROUTE 112 AND EXIT 35 SB	Lump Sum	1				
643.81	TRAFFIC SIGNAL AT LUND RD AND EXIT 35 NB	Lump Sum	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
643.82	VEHICLE DETECTION SYSTEM AT LUND RD AND EXIT 35 NB	Lump Sum	1				
643.83	VEHICLE DETECTION SYSTEM AT ROUTE 112 AND EXIT 35 SB	Lump Sum	1				
643.92	PEDESTAL POLE	Each	4				
643.941	DUAL PURPOSE POLE W/15' MAST ARM	Each	2				
643.942	DUAL PURPOSE POLE W/25' MAST ARM	Each	1				
643.943	DUAL PURPOSE POLE W/30' MAST ARM	Each	1				
643.944	DUAL PURPOSE POLE W/35' MAST ARM	Each	2				
643.945	DUAL PURPOSE POLE W/40' MAST ARM	Each	1				
643.946	DUAL PURPOSE POLE W/45' MAST ARM	Each	1				
645.105	REMOVE AND STACK SIGN	Each	1				
645.109	REMOVE AND RESET SIGN	Each	23				
645.1092	CANOPY MOUNTED DYNAMIC MESSAGE SIGN	Each	2				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
645.1099	REMOVE AND DISPOSE SIGN	Each	30				
645.121	OVERHEAD GUIDE SIGN NB 1 (STA. 1670+75)	Lump Sum	1				
645.14	CANOPY MOUNTED SIGN	Each	4				
645.151	CANTILEVER GUIDE SIGN NB 1 (STA. 1718+50)	Lump Sum	1				
645.152	CANTILEVER GUIDE SIGN NB 2 (STA. 1731+30)	Lump Sum	1				
645.153	CANTILEVER GUIDE SIGN SB 1 (STA 2728+75)	Lump Sum	1				
645.154	CANTILEVER GUIDE SIGN SB 2 (STA 2740+50)	Lump Sum	1				
645.155	CANTILEVER GUIDE SIGN SB 3 (STA. 2763+00)	Lump Sum	1				
645.156	CANTILEVER GUIDE SIGN SB 4 (STA. 1789+00)	Lump Sum	1				
645.161	BREAKAWAY DEVICE SINGLE POLE	Each	35				
645.162	BREAKAWAY DEVICE MULTI POLE	Each	35				
645.251	ROADSIDE GUIDE SIGNS, TYPE I	Square Foot	3,400				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
645.2511	SHEET ALUMINUM OVERLAY, TYPE I	Square Foot	3				
645.271	REGULATORY, WARNING, CONFIRMATION AND ROUTE ASSEMBLY SIGN, TYPE I	Square Foot	1,300				
645.289	STEEL H-BEAM POLES	Pound	28,600				
645.501	REMOVE AND RESET MAINLINE SIGN NO. 1	Lump Sum	1				
645.502	REMOVE AND RESET MAINLINE SIGN NO. 2	Lump Sum	1				
645.503	REMOVE AND RESET MAINLINE SIGN NO. 3	Lump Sum	1				
645.504	REMOVE AND RESET MAINLINE SIGN NO. 4	Lump Sum	1				
645.505	REMOVE AND RESET MAINLINE SIGN NO. 5	Lump Sum	1				
645.506	REMOVE AND RESET MAINLINE SIGN NO. 6	Lump Sum	1				
645.507	REMOVE AND RESET MAINLINE SIGN NO. 7	Lump Sum	1				
645.508	REMOVE AND RESET MAINLINE SIGN NO. 8	Lump Sum	1				
645.509	REMOVE AND RESET MAINLINE SIGN NO. 9	Lump Sum	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
645.510	REMOVE AND RESET MAINLINE SIGN NO. 10	Lump Sum	1				
645.511	REMOVE AND RESET MAINLINE SIGN NO. 11	Lump Sum	1				
648.00	INSTALL FLAGPOLE	Each	2				
650.1011	VARIABLE MESSAGE SIGN (VMS) SYSTEM: ROUTE 112 EB	Lump Sum	1				
650.1012	VARIABLE MESSAGE SIGN (VMS) SYSTEM: ROUTE 112 WB	Lump Sum	1				
650.2011	VMS GROUND MOUNTED CONTROL CABINET: ROUTE 112 EB	Each	1				
650.2012	VMS GROUND MOUNTED CONTROL CABINET: ROUTE 112 WB	Each	1				
650.9011	VMS SOLAR POWER SYSTEM: ROUTE 112 EB	Lump Sum	1				
650.9012	VMS SOLAR POWER SYSTEM: ROUTE 112 WB	Lump Sum	1				
652.30	FLASHING ARROW	Each	4				
652.312	TYPE III BARRICADES	Each	18				
652.313	TEMPORARY PEDESTRIAN BARRICADE, ADA COMPLIANT	Linear Foot	2,150				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
652.33	DRUM	Each	550				
652.34	CONE	Each	100				
652.35	CONSTRUCTION SIGNS	Square Foot	4,400				
652.361	MAINTENANCE OF TRAFFIC CONTROL DEVICES	Lump Sum	1				
652.38	FLAGGERS	Hour	3,250				
652.381	TRAFFIC OFFICERS	Hour	50				
652.41	PORTABLE-CHANGEABLE MESSAGE SIGN	Each	10				
652.45	TRUCK MOUNTED ATTENUATOR	Cal. Day	200				
652.452	AUTOMATED TRAILER MOUNTED SPEED LIMIT SIGN	Each	3				
652.46	TEMPORARY PORTABLE RUMBLE STRIPS	Unit	50				
652.47	SEQUENTIAL FLASHING WARNING LIGHTS	Each	30				
655.012	INSTALLATION OF CASH LANE CONTROLLER CABINET	Each	8				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
655.02	DVAS MOUNT INSTALLATION	Each	8				
655.041	INSTALLATION OF SENSOR LOOPS - SOUTHBOUND	Lump Sum	1				
655.042	INSTALLATION OF SENSOR LOOPS - NORTHBOUND	Lump Sum	1				
655.05	INSTALLATION OF AVI ANTENNAS	Each	10				
655.07	TRAFFIC CONTROL PEDESTAL PREPARATION WORK	Each	6				
655.1000	#2/0 AWG WIRE	Linear Foot	4,820				
655.101	#6 AWG WIRE	Linear Foot	2,216				
655.102	#2 AWG WIRE	Linear Foot	12,400				
655.11	#10 AWG WIRE	Linear Foot	1,205				
655.12	#12 AWG WIRE	Linear Foot	24,900				
655.13	#14 AWG WIRE	Linear Foot	100				
655.141	4PR/24 (CATEGORY 5E) CABLE	Linear Foot	6,830				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
655.151	LMR 600 CABLE	Linear Foot	870				
655.16	6 STRAND MULTI-MODAL FIBER OPTIC CABLE	Linear Foot	4,700				
655.17	IVIS HOMERUN LOOP CABLE (IMSA 50-2 #14)	Linear Foot	100				
655.200	1-1/2" SCHEDULE 40 PVC CONDUIT	Linear Foot	60				
655.201	3" SCHEDULE 40 PVC CONDUIT	Linear Foot	100				
655.2021	1" SCHEDULE 80 PVC CONDUIT	Linear Foot	130				
655.203	1 1/2" SCHEDULE 80 PVC CONDUIT	Linear Foot	370				
655.2031	2" SCHEDULE 80 PVC CONDUIT	Linear Foot	180				
655.204	3" SCHEDULE 80 PVC CONDUIT	Linear Foot	14,420				
655.206	1" GALVANIZED RIGID METAL CONDUIT	Linear Foot	300				
655.207	1 1/2" GALVANIZED RIGID METAL CONDUIT	Linear Foot	100				
655.2071	2" GALVANIZED RIGID METAL CONDUIT	Linear Foot	310				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
655.208	3" GALVANIZED RIGID METAL CONDUIT	Linear Foot	210				
655.209	1/2" LIQUID TIGHT METALLIC FLEXIBLE CONDUIT	Linear Foot	50				
655.2101	1 1/2" LIQUID TIGHT METALLIC FLEXIBLE CONDUIT	Linear Foot	100				
655.2102	2" LIQUID TIGHT METALLIC FLEXIBLE CONDUIT	Linear Foot	100				
655.221	TYPE A PULL BOX INSIDE	Each	10				
655.2212	TYPE B PULL BOX OUTDOOR	Each	8				
655.222	TYPE C PULL BOX INSIDE	Each	12				
655.223	TYPE D PULL BOX OUTDOOR	Each	8				
655.224	TYPE E PULL BOX INSIDE	Each	8				
655.225	TYPE F PULL BOX OUTDOOR	Each	16				
655.227	TYPE H PULL BOX OUTDOOR	Each	16				
655.42	36" X 30" X 20" NEMA 4X CABINET	Each	3				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
655.421	EXIT TOLL POWER AND COMMUNICATION CABINET	Each	1				
655.501	1" PVC CONDUIT CONDULETS	Each	10				
655.502	1-1/2" PVC CONDUIT CONDULETS	Each	10				
655.503	2" PVC CONDUIT CONDULETS	Each	24				
655.504	3" PVC CONDUIT CONDULETS	Each	16				
655.512	1" RIGID METAL CONDUIT CONDULETS	Each	20				
655.513	1-1/2" RIGID METAL CONDUIT CONDULETS	Each	20				
655.514	2" RIGID METAL CONDUIT CONDULETS	Each	16				
655.515	3" RIGID METAL CONDUIT CONDULETS	Each	10				
655.63	4-INCH X 4-INCH PLASTIC NEMA 4X WIREWAY	Linear Foot	160				
655.64	6-INCH X 6-INCH PLASTIC NEMA 4X WIREWAY	Linear Foot	160				
655.801	LIGHTNING SUPPRESSION SYSTEM - SOUTHBOUND ENTRY AND EXIT	Lump Sum	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
655.802	LIGHTNING SUPPRESSION SYSTEM - NORTHBOUND ENTRY AND EXIT	Lump Sum	1				
655.81	KEY SWITCH	Each	14				
655.82	DUPLEX RECEPTACLE	Each	4				
655.84	QUADPLEX RECEPTACLE	Each	4				
655.92	LED CANOPY LIGHT FIXTURE	Each	12				
655.99	LED BUMPER BEACON	Each	6				
656.50	BALED HAY, IN-PLACE	Each	50				
656.60	TEMPORARY BERMS	Linear Foot	3,000				
656.62	TEMPORARY SLOPE DRAINS	Linear Foot	500				
656.632	30" TEMPORARY SILT FENCE	Linear Foot	21,660				
659.10	MOBILIZATION	Lump Sum	1				
670.011	SEWAGE DISPOSAL SYSTEM - SOUTHBOUND	Lump Sum	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
673.01	STORMWATER SOIL FILTER BED	Cubic Yard	1,400				
674.10	PREFABRICATED CONCRETE MODULAR GRAVITY WALL - GOOSEFARE BROOK	Lump Sum	1				
800.01	TOLL ADMINISTRATION BUILDING - NORTHBOUND	Lump Sum	1				
800.011	UTILITY BUILDING - NORTHBOUND	Lump Sum	1				
800.02	TOLL ADMINISTRATION BUILDING - SOUTHBOUND	Lump Sum	1				
800.401	NEW TOLL BOOTH INSTALLATION - SOUTHBOUND	Lump Sum	1				
800.402	NEW TOLL BOOTH INSTALLATION - NORTHBOUND	Lump Sum	1				
800.901	GENERATOR PAD - SOUTHBOUND	Lump Sum	1				
800.902	GENERATOR PAD - NORTHBOUND	Lump Sum	1				
800.91	TRANSFORMER PAD	Lump Sum	1				
800.921	STAND-BY GENERATOR AND TRANSFER SWITCH - SOUTHBOUND	Lump Sum	1				
800.922	STAND-BY GENERATOR AND TRANSFER SWITCH - NORTHBOUND	Lump Sum	1				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
			BROUGHT FORWARD:				
801.16	6" PVC SANITARY SEWER (SDR-35)	Linear Foot	120				
801.17	8" PVC SANITARY SEWER (SDR-35)	Linear Foot	490				
803.01	TEST PITS	Each	11				
803.173	SEWER MANHOLE - 4 FOOT DIAMETER	Each	2				
810.01	MAIN INSTALLATION 6" VIA TRENCH ,DUCTILE IRON (HYDRANT LATERAL)	Linear Foot	50				
810.02	MAIN INSTALLATION 8" VIA TRENCH HDPE (INCLUDES HDPE SLEEVE)	Linear Foot	370				
810.03	MAIN INSTALLATION 12" VIA TRENCH, DUCTILE IRON	Linear Foot	600				
811.01	HYDRANT INSTALLATION	Each	3				
812.01	TEMPORARY BLOWOFF ASSEMBLY	Each	1				
813.01	CONNECT TO EXISTING MAIN	Each	6				
820.01	THRUST BLOCK	Each	12				
832.41	TYPE A STEEL SITE BOLLARD	Each	30				

CARRIED FORWARD:

Item No	Item Description	Units	Approx. Quantities	Unit Prices in Numbers		Bid Amount in Numbers	
				Dollars	Cents	Dollars	Cents
BROUGHT FORWARD:							
845.301	RELOCATE BUSINESS SIGN NO. 1	Each	1				
845.302	RELOCATE BUSINESS SIGN NO. 2	Each	1				
845.303	RELOCATE BUSINESS SIGN NO. 3	Each	1				
TOTAL:							

Acknowledgment is hereby made of the following Addenda received since issuance of the Plans and Specifications: _____

_____

_____

Accompanying this Proposal is an original bid bond, cashiers or certified check on _____ Bank, for _____, payable to the Maine Turnpike Authority. In case this Proposal shall be accepted by the Maine Turnpike Authority and the undersigned should fail to execute a Contract with, and furnish the security required by the Maine Turnpike Authority as set forth in the Specifications, within the time fixed therein, an amount of money equal to Five (5%) Percent of the Total Amount of the Proposal for the Contract awarded to the undersigned, but not less than $500.00, obtained out of the original bid bond, cashier's or certified check, shall become the property of the Maine Turnpike Authority; otherwise the check will be returned to the undersigned.

The performance of said Work under this Contract will be completed during the time specified in Subsection 107.1.

It is agreed that time is of the essence of this Contract and that I (we) will, in the event of my (our) failure to complete the Work within the time limit named above, pay to Maine Turnpike Authority liquidated damages in the amount or amounts stated in the Specifications.

The undersigned is an Individual/Partnership/Corporation under the laws of the State of _____, having principal office at _____, thereunto duly authorized.

_____ *(SEAL)*

_____ *(SEAL)*

Affix Corporate Seal
or Power of Attorney
Where Applicable

_____ *(SEAL)*

By: _____

Its: _____

Information below to be typed or printed where applicable:

INDIVIDUAL:

(Name)	(Address)

PARTNERSHIP - Name and Address of General Partners:

(Name)	(Address)
(Name)	(Address)
(Name)	(Address)
(Name)	(Address)

INCORPORATED COMPANY:

(President)	(Address)
(Vice-President)	(Address)
(Secretary)	(Address)
(Treasurer)	(Address)

MAINE TURNPIKE AUTHORITY

MAINE TURNPIKE

YORK TO AUGUSTA

CONTRACT AGREEMENT

This Agreement made and entered into between the Maine Turnpike Authority, and sometimes termed the "Authority", and _____

_____

herein termed the "Contractor":

WITNESSETH: That the Authority and the Contractor, in consideration of the premises and of the mutual covenants, considerations and agreements herein contained, agree as follows:

FIRST: The parties hereto mutually agree that the documents attached hereto and herein incorporated and made a part hereof collectively evidencing and constituting the entire Contract to the same extent as if herein written in full, are the Notice to Contractors, the Accepted Proposal, the Specifications, the Plans, this Agreement, the Contract Bond and all Addenda to the Contract Documents duly issued and herewith enumerated:

_____

_____

SECOND: The Contractor for and in consideration of certain payments to be made as hereafter specified, hereby covenants and agrees to perform and execute all of the provisions of this Contract and of all documents and parts attached hereto and made a part thereof, and at his own cost and expense to furnish and perform everything necessary and required to construct and complete, ready for its intended purpose, in accordance with the Contract and such instructions as the Engineer may give, acceptable to the Authority, in the times provided, all of the Work covered and included under Contract No. _____ covering _____ as herein described.

THIRD: In consideration of the performance by the Contractor of his covenants and agreements as herein set forth, the Authority hereby covenants and agrees to pay the Contractor according to the Schedule of Prices set forth in the Proposal with additions and deductions as elsewhere herein provided in the times and in the manner stated in the Specifications. This Agreement shall insure to the benefit of, and shall be binding upon the parties hereto, and upon their respective successors and assigns; but neither party hereto shall assign or transfer his interest herein in whole or in part without the consent of the other, except as herein provided.

IN WITNESS WHEREOF the parties to this Agreement have executed the same in quintuplicate.

AUTHORITY -

MAINE TURNPIKE AUTHORITY

By: _____

Title: CHAIRMAN

Date of Signature: _____

ATTEST:

_____
Secretary

CONTRACTOR -

_____
CONTRACTOR

By: _____

Title: _____

Date of Signature: _____

WITNESS:

_____

CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS that _____

of _____ in the County of _____ and State of _____

as Principal, and _____ a Corporation duly organized under the

laws of the State of _____ and having a usual place of business in _____

_____

As Surety, are held and firmly bound unto the Maine Turnpike Authority in the sum of _____Dollars ($_____.___), to be paid to said Maine Turnpike Authority, or its successors, for which payment, well and truly to be made, we bind ourselves, our heirs, executors, successors and assigns jointly and severally by these presents.

The condition of this obligation is such that the Principal, designated as Contractor in the foregoing Contract No. _____ shall faithfully perform the Contract on his part and satisfy all claims and demands incurred for the same and shall pay all bills for labor, material, equipment and all other items contracted for, or used by him, in connection with the Work contemplated by said Contract, and shall fully reimburse the Obligee for all outlay and expense which the Obligee may incur in making good any default of said Principal, then this Obligation shall be null and void; otherwise it shall remain in full force and effect.

Signed and sealed this _____ day of _____, A.D., 202___

Witnesses: CONTRACTOR

_____ _____ *(SEAL)*

_____ _____ *(SEAL)*

_____ _____ *(SEAL)*

SURETY

_____ _____ *(SEAL)*

_____ _____ *(SEAL)*

_____ _____ *(SEAL)*

(Surety must attach copy of Power of Attorney showing authority of Office or Agent to execute bonds)

FINAL LIEN AND CLAIM WAIVER AND AFFIDAVIT

Upon receipt of the sum of _____, which sum represents the total amount paid, including the current payment for work done and materials supplied for Project No. _____, in _____, Maine, under the undersigned's Contract with the Maine Turnpike Authority.

The undersigned, on oath, states that the Final Payment of _____ is the final payment for all work, labor, materials, services and miscellaneous (all of which are hereinafter referred to as "Work Items") supplied to the said Project through _____and that no additional sum is claimed by the undersigned respecting said Project.

The undersigned, on oath, states that all persons and firms who supplied Work Items to the undersigned in connection with said Project have been fully paid by the undersigned for such Work Items or that such payment will be fully effected immediately upon receipt of this payment.

In consideration of the payment herewith made, the undersigned does fully and finally release and hold harmless the Maine Turnpike Authority, and its Surety, if any, from any and all claims, liens or right to claim or lien, arising out of this Project under any applicable bond, law or statute.

It is understood that this Affidavit is submitted to assure the Owner and others that all liens and claims relating to the Work Items furnished by the undersigned are paid.

_____
(Contractor)

By: _____

Title: _____

State of MAINE

County of _____

I, _____, hereby certify on behalf of _____
(Company Officer) *(Company Name)*

its _____, being first duly sworn and stated that the foregoing representations are
(Title)

are true and correct upon his own knowledge and that the foregoing is his free act and deed in said capacity and the free act and deed of the above-named _____
(Company Name)

The above-named, _____, personally appeared before me this ____ day of _____ and swears that this is his free act and deed.

(SEAL)

_____
Notary Public

My Commission Expires: _____

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART I – SUPPLEMENTAL SPECIFICATIONS

(Rev. November 10, 2016)

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART II – SPECIAL PROVISIONS

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART II - SPECIAL PROVISIONS

All work shall be governed by the Maine Department of Transportation Standard Specifications, Revision of November 2014, except for that work which applies to sections of the Maine Department of Transportation Standard Specifications which are amended by the Maine Turnpike Supplemental Specifications and the following modifications, additions and deletions.

General Description of Work

The work consists of highway, interchange, and toll system construction at Exit 35 in Saco and modifications to the Exit 36 Interchange in Saco. The work includes a new interchange at MM 35, including southbound and northbound ramps, a new southbound toll plaza on the west side of the Maine Turnpike with a signalized intersection at Route 112, a new northbound toll plaza on the east side of the Maine Turnpike with a signalized intersection at Route 112, widening of the southbound Maine Turnpike to construct a separated collector-distributor road, widening of Route 112, and construction of access roads. The work includes earthwork, pavement, concrete, signing, overhead sign structures, concrete barrier, guardrail, drainage, stormwater management, electrical work, highway lighting, lightning suppression systems, and maintenance of traffic. The toll plaza work includes installation of tolling equipment, administration buildings, canopies, and toll booths and all other work incidental thereto in accordance with the Plans and Specifications.

Plans

The drawings included in these Contract Documents, and referred to as the Plans, show the general character of the work to be done under this Contract. They bear the general title "Maine Turnpike – Contract 2022.07 – Interchange Improvements Saco (Exits 35 &36) MM 34.7 TO MM 36.6". The right is reserved by the Resident to make such minor corrections or alterations in the Plans as he deems necessary without change in the unit prices on the Schedule of Prices of the Proposal.

101.2 Definition

Holidays

The following is added after Memorial Day in the Supplemental Specifications:

Christmas 2022	12:01 p.m. preceding Friday to 6:00 a.m. the following Tuesday.
New Year's 2023	12:01 p.m. preceding Friday to 6:00 a.m. the following Tuesday.
Juneteenth 2023 (June 19th)	

Independence Day 2023 (Fourth of July)	12:01 p.m. preceding Friday to 6:00 a.m. the following Thursday.
Christmas 2023	12:01 p.m. preceding Friday to 6:00 a.m. the following Wednesday.
New Year's 2024	12:01 p.m. preceding Friday to 6:00 a.m. the following Tuesday.
Juneteenth 2024 (June 19th)	
Independence Day 2024 (Fourth of July)	12:01 p.m. preceding Wednesday to 6:00 a.m. the following Monday.
Christmas 2024	6:00 a.m. preceding Tuesday to 6:00 a.m. the following Friday.
New Year's 2025	6:00 a.m. preceding Tuesday to 6:00 a.m. the following Thursday.
Juneteenth 2025 (June 19th)	
Independence Day 2025 (Fourth of July)	12:01 p.m. preceding Thursday to 6:00 a.m. the following Monday.

103.4 Notice of Award

The following sentence is added:

The Maine Turnpike Authority Board is scheduled to consider the Contract Award on November 17, 2022.

104.3.8 Wage Rates and Labor Laws

Section 104.3.8 Wage Rates and Labor Laws has been amended as follows:

The fair minimum hourly rates determined by the State of Maine Department of Labor for this Contract are as follows:

THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS

State of Maine
Department of Labor
Bureau of Labor Standards
Augusta, Maine 04333-0045
Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2022 Fair Minimum Wage Rates
Highway & Earth York County

Occupational Title	Minimum Wage	Minimum Benefit	Total
Carpenter	$26.40	$6.45	$32.85
Cement Masons And Concrete Finisher	$20.00	$0.00	$20.00
Commercial Divers	$28.00	$2.50	$30.50
Construction And Maintenance Painters	$23.34	$2.53	$25.87
Construction Laborer	$23.00	$0.00	$23.00
Control And Valve Installers And Repairers - Except Mechanical Door	$26.00	$5.49	$31.49
Conveyor Operators And Tenders	$18.00	$2.71	$20.71
Crane And Tower Operators	$31.54	$6.68	$38.22
Crushing Grinding And Polishing Machine Operators	$21.00	$4.52	$25.52
Earth Drillers - Except Oil And Gas	$23.25	$5.53	$28.78
Electricians	$33.37	$15.69	$49.06
Excavating And Loading Machine And Dragline Operators	$28.10	$4.42	$32.52
Fence Erectors	$18.00	$0.72	$18.72
Flaggers	$17.00	$0.00	$17.00
Heating And Air Conditioning And Refrigeration Mechanics And Installers	$26.33	$4.06	$30.39
Heavy And Tractor - Trailer Truck Drivers	$24.00	$2.67	$26.67
Highway Maintenance Workers	$21.50	$1.87	$23.37
Industrial Machinery Mechanics	$26.00	$5.19	$31.19
Industrial Truck And Tractor Operators	$24.00	$5.61	$29.61
Light Truck Or Delivery Services Drivers	$20.00	$2.30	$22.30
Millwrights	$25.13	$3.51	$28.64
Mixing And Blending Machine Operators	$24.71	$8.59	$33.30
Mobile Heavy Equipment Mechanics - Except Engines	$25.13	$3.28	$28.41
Operating Engineers And Other Equipment Operators	$32.20	$2.00	$34.20
Paving Surfacing And Tamping Equipment Operators	$24.34	$4.28	$28.62
Pipelayers	$28.00	$7.20	$35.20
Plumbers Pipe Fitters And Steamfitters	$26.75	$2.69	$29.44
Reinforcing Iron And Rebar Workers	$48.58	$0.00	$48.58
Structural Iron And Steel Workers	$24.00	$1.36	$25.36

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rate for registered apprentices are those set forth in the standards and policies of the Maine State Apprenticeship and Training Council for approved apprenticeship programs.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest: Scott R. Cotnoir

Scott R. Cotnoir
Wage & Hour Director
Bureau of Labor Standards

Expiration Date: 12-31-2022

THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS

State of Maine
Department of Labor
Bureau of Labor Standards
Augusta, Maine 04333-0045
Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2022 Fair Minimum Wage Rates
Heavy & Bridge York County

Occupational Title	Minimum Wage	Minimum Benefit	Total
Carpenter	$29.00	$5.46	$34.46
Cement Masons And Concrete Finisher	$20.04	$1.02	$21.06
Commercial Divers	$34.00	$4.98	$38.98
Construction And Maintenance Painters	$34.00	$0.00	$34.00
Construction Laborer	$23.02	$5.06	$28.08
Conveyor Operators And Tenders	$16.50	$0.00	$16.50
Crane And Tower Operators	$30.25	$7.89	$38.14
Crushing Grinding And Polishing Machine Operators	$21.00	$4.38	$25.38
Earth Drillers - Except Oil And Gas	$23.25	$5.53	$28.78
Electrical Power - Line Installer And Repairers	$40.96	$14.49	$55.45
Electricians	$31.85	$7.70	$39.55
Excavating And Loading Machine And Dragline Operators	$32.50	$5.61	$38.11
Flaggers	$21.00	$0.58	$21.58
Heating And Air Conditioning And Refrigeration Mechanics And Installers	$26.33	$4.06	$30.39
Heavy And Tractor - Trailer Truck Drivers	$23.25	$3.22	$26.47
Highway Maintenance Workers	$21.66	$3.22	$24.88
Industrial Machinery Mechanics	$20.00	$5.00	$25.00
Industrial Truck And Tractor Operators	$24.00	$5.61	$29.61
Ironworker - Ornamental	$25.00	$3.32	$28.32
Light Truck Or Delivery Services Drivers	$24.50	$6.23	$30.73
Millwrights	$32.28	$17.41	$49.69
Mobile Heavy Equipment Mechanics - Except Engines	$30.87	$7.63	$38.50
Operating Engineers And Other Equipment Operators	$36.80	$28.90	$65.70
Paving Surfacing And Tamping Equipment Operators	$35.11	$0.00	$35.11
Pile-Driver Operators	$30.54	$8.93	$39.47
Pipelayers	$30.00	$7.20	$37.20
Plumbers Pipe Fitters And Steamfitters	$32.86	$18.00	$50.86
Radio Cellular And Tower Equipment Installers	$27.00	$0.00	$27.00
Reinforcing Iron And Rebar Workers	$27.60	$35.40	$63.00
Riggers	$25.25	$9.62	$34.87
Sheet Metal Workers	$24.00	$5.48	$29.48
Structural Iron And Steel Workers	$32.50	$4.50	$37.00
Telecommunications Line Installers And Repairers	$25.00	$4.15	$29.15

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rate for registered apprentices are those set forth in the standards and policies of the Maine State Apprenticeship and Training Council for approved apprenticeship programs.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest: Scott R. Cotnoir
Scott R. Cotnoir
Wage & Hour Director
Bureau of Labor Standards

Expiration Date: 12-31-2022

THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS

State of Maine
Department of Labor
Bureau of Labor Standards
Augusta, Maine 04333-0045
Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2022 Fair Minimum Wage Rates
Building 2 York County
(other than 1 & 2 family homes)

Occupational Title	Minimum Wage	Minimum Benefit	Total
Brickmasons And Blockmasons	$35.00	$0.00	$35.00
Carpenter	$26.40	$5.08	$31.48
Carpet Installers	$20.50	$0.72	$21.22
Cement Masons And Concrete Finisher	$22.56	$3.84	$26.40
Construction And Maintenance Painters	$23.33	$1.72	$25.05
Construction Laborer	$21.00	$2.71	$23.71
Control And Valve Installers And Repairers - Except Mechanical Door	$26.00	$5.49	$31.49
Crane And Tower Operators	$26.38	$5.98	$32.36
Drywall And Ceiling Tile Installers	$29.31	$3.55	$32.86
Earth Drillers - Except Oil And Gas	$23.25	$5.53	$28.78
Electricians	$31.45	$15.84	$47.29
Elevator Installers And Repairers	$56.69	$42.31	$99.00
Excavating And Loading Machine And Dragline Operators	$24.00	$3.50	$27.50
Fence Erectors	$23.00	$5.43	$28.43
Floor Layers - Except Carpet/Wood/Hard Tiles	$22.00	$5.32	$27.32
Glaziers	$20.00	$2.23	$22.23
Hazardous Materials Removal Workers	$21.00	$3.18	$24.18
Heating And Air Conditioning And Refrigeration Mechanics And Installers	$30.00	$4.43	$34.43
Heavy And Tractor - Trailer Truck Drivers	$20.50	$1.92	$22.42
Industrial Machinery Mechanics	$26.00	$5.82	$31.82
Industrial Truck And Tractor Operators	$24.00	$5.61	$29.61
Insulation Workers - Floor Ceiling And Wall	$26.50	$4.78	$31.28
Ironworker - Ornamental	$25.00	$3.32	$28.32
Light Truck Or Delivery Services Drivers	$20.00	$2.30	$22.30
Mobile Heavy Equipment Mechanics - Except Engines	$26.25	$4.37	$30.62
Operating Engineers And Other Equipment Operators	$26.00	$2.15	$28.15
Paving Surfacing And Tamping Equipment Operators	$33.12	$0.00	$33.12
Pipelayers	$28.00	$7.20	$35.20
Plumbers Pipe Fitters And Steamfitters	$28.63	$5.21	$33.84
Reinforcing Iron And Rebar Workers	$21.00	$5.69	$26.69
Roofers	$22.00	$3.18	$25.18
Sheet Metal Workers	$25.00	$4.55	$29.55
Sider	$18.00	$2.44	$20.44
Structural Iron And Steel Workers	$25.50	$5.87	$31.37
Tapers	$28.00	$3.60	$31.60
Telecommunications Equipment Installers And Repairers - Except Line Installers	$33.43	$10.81	$44.24
Tile And Marble Setters	$25.50	$5.30	$30.80

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rate for registered apprentices are those set forth in the standards and policies of the Maine State Apprenticeship and Training Council for approved apprenticeship programs.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest: Scott R. Cotnoir
Scott R. Cotnoir
Wage & Hour Director
Bureau of Labor Standards

Expiration Date: 12-31-2022

104.4.6 Utility Coordination

This Subsection is amended by the addition of the following:

These Special Provisions outline the arrangements which have been established by the Authority for coordination of the work to be accomplished by the utilities. The scope and schedule of utility relocation work is noted herein. The Contractor shall plan and conduct his work accordingly.

General

Utility working days are Monday through Friday, conditions permitting. Times are estimated on the basis of a single crew for each utility. Any times and dates mentioned are estimates only and are dependent upon favorable weather, working conditions, and freedom from emergencies. The Contractor shall have no claim against the Authority if they are exceeded.

The Contractor shall plan and conduct his operations in accordance with the following utility schedule. The Contractor must comply with all OSHA regulations pertaining to work adjacent to utility wires. The Contractor shall plan and conduct his work accordingly.

The following utilities are located within the Project limits. The Contractor shall ascertain the location of the existing utilities and any other necessary information by direct inquiry at the office of the following utility owners:

AERIAL AND UNDERGROUND UTILITIES

COMMUNICATION:
Consolidated Communications
5 Davis Farm Road
Portland, ME 04103
(207) 797-1554
ATTN: Mark Wentworth

COMMUNICATION:
Charter Communications
118 Johnson Road
Portland, ME 04102
(207) 272-7993
ATTN: Chip Deane

ELECTRIC:
Central Maine Power Company
83 Edison Drive
Augusta, ME 04336
(207) 626-9443
ATTN: Jay Agreste

WATER:
Maine Water Company
93 Industrial Park Rd
Saco, ME 04072
(207) 294-6904
ATTN: Mickey Hall

NATURAL GAS
Unitil
376 Riverside Industrial Parkway
Portland, ME 04103
(207) 620-3411
ATTN: Derick Giroux

COMMUNICATION:
Oxford Networks/FirstLight
14 Resilient Circle
Brunswick, ME 04011
(207) 318-8874
ATTN: Richard Mankin

SEWER
Saco Water Resource Recovery Department
15 Phillips Spring Rd
Saco, ME 04072
(207) 284-6641
ATTN: Patrick Fox

COMMUNICATION:
Otelco
56 Campus Drive
New Gloucester, ME 04260
(207) 688-8284
ATTN: Jim Knight

CENTRAL MAINE POWER (CMP)

CMP will be setting new poles, services, and transformers for the proposed Northbound and Southbound Administration Buildings. The contractor shall be responsible for the conduit, junction boxes, and transformer pads from the new pole to the new administration building. CMP will de-energize service to the existing lighting along the current hotel and conference center ramps.

CMP will be installing a new underground service along the Hotel Access Road for the relocation of the existing service to the Ramada Inn. The contractor shall clear, grub, and construct any fills or cuts needed to facilitate the work along with installing conduit and junction boxes as shown on the plans. CMP estimates fifteen (15) working days to install new wiring for the underground service. The existing service must be maintained until the new service is energized.

In addition to the new service work, CMP has aerial facilities within these project limits and will be first in transferring their facilities onto the relocated poles. CMP plans to begin installation of their cables as soon as Consolidated Communications have completed the new pole installation work. Twenty-five (25) working days are estimated to complete the CMP transfers.

The contractor shall notify CMP ten (10) working days prior to the utility coordination meeting and at least fifteen (15) working days' notice before any work will commence. The coordination effort is to relay contractor's construction schedule, determine covering of aerial conductors and schedule of the new service.

CONSOLIDATED COMMUNICATIONS

Consolidated Communications will be providing a new service to the new Northbound Administration Building. The contractor shall be responsible for the conduit and junction boxes from the new pole to the new administration buildings.

Consolidated Communications will also be relocating the existing underground service to the Ramada Inn to a new undergound service along the Hotel Access Road. The contractor shall be responsible for the conduit and junction boxes from the new service pole to the existing splice box near the Ramada Inn entrance as shown on the plans.

Consolidated Communications will also be relocating several poles along Route 112 as noted in the included Pole List. The contractor shall clear, grub, and construct any fills or cuts needed to install the poles along with staking its location as shown on the plans. The contractor must also provide access and adequate work area at each of the new pole locations. Ten (10) working days are estimated to set the new poles and an additional five (5) working days will be needed to remove the retired existing poles.

Consolidated Communications plans to transfer their cables to the new pole locations as well, they will be following CMP and Charter. Twenty-five (25) working days are estimated to complete the Consolidated Communications transfers.

The contractor shall notify Consolidated Communications ten (10) working days prior to the utility coordination meeting and at least fifteen (15) working days' notice before any work will commence. The coordination effort is to relay contractor's construction schedule, determine possible covering of aerial conductors and schedule of the new service.

CHARTER COMMUNICATIONS

Charter Communications will be providing a new service to the new Northbound Administration Building. The contractor shall be responsible for the conduit and junction boxes from the new pole to the new administration buildings.

Charter Communications has aerial facilities within these project limits and will be following CMP in transferring their facilities onto the relocated poles. Charter Communications plans to begin installation of their cables as soon as CMP have completed their cable work. Ten (10) working days are estimated to complete the Charter transfers.

The contractor shall notify Charter Communications ten (10) working days prior to the utility coordination meeting and at least fifteen (15) working days' notice before any work will commence. The coordination effort is to relay contractor's construction schedule, determine possible covering of aerial conductors and schedule of the new service.

OXFORD NETWORKS / FIRSTLIGHT COMMUNICATIONS

Oxford Networks has aerial facilities within these project limits and will be transferring their facilities onto the relocated poles. Oxford Networks plans to begin installation of their cables after CMP, Charter, and Consolidated Communications. Ten (10) working days are estimated to complete the Oxford Network transfers.

The contractor shall notify FirstLight Communications ten (10) working days prior to the utility coordination meeting and at least fifteen (15) working days' notice before any work will commence. The coordination effort is to relay contractor's construction schedule, determine possible covering of aerial conductors and schedule of the new service.

OTELCO

Otelco has aerial facilities within these project limits and will be last in transferring their facilities onto the relocated poles. Otelco plans to begin installation of their cables after all other utilities have performed their transfers. Ten (10) working days are estimated to complete the Otelco transfers.

The contractor shall notify Otelco ten (10) working days prior to the utility coordination meeting and at least fifteen (15) working days' notice before any work will commence. The coordination effort is to relay contractor's construction schedule, determine possible covering of aerial conductors and schedule of the new service.

MAINE WATER COMPANY

The contractor will coordinate and install the water service to each of the new Administration buildings with the Maine Water Company.

Maine Water Company has entered into an agreement with the Maine Turnpike Authority to include the removal and replacement of a portion of their existing water main system in two locations the Authority's contract. The contractor shall perform the water work as part of the bid document and include the water work in the schedule for construction. The water work shall be completed in accordance with the Plans and Specifications provided by Maine Water Company included in this contract.

Maine Water Company plans to close valves in various locations to facilitate the removal of the existing water main. These shutdowns are to be of short duration not exceeding 2 weeks and will need to be coordinated with the Main Water Company, two (2) working days shall be provided for notice of need to shut down water main.

The contractor will be responsible for raising all gates during milling and paving operations. The payment for this work will be incidental to the paving items.

The contractor shall notify Maine Water Company ten (10) working days prior to the utility coordination meeting. The coordination effort is to relay contractor's construction schedule and schedule of the new services and relocation work.

UNITIL

The contractor will coordinate and assist Unitil with the installation of the natural gas service for the Northbound Administration building as well as the relocation of the existing natural gas service to the Ramada Inn. Contractor will be responsible for all excavation and trenching required. Unitil will be installing the gas service and will supply all materials needed to perform that work. Fifteen (15) working days are estimated to complete the new gas service installation and the existing gas service relocation.

The contractor will be responsible for raising all gates during milling and paving operations. The payment for this work will be incidental to the paving items.

The contractor shall notify Unitil ten (10) working days prior to the utility coordination meeting. The coordination effort is to relay contractor's construction schedule and schedule of installing the new service. The contractor shall also notify Unitil thirty (30) working days before any work needs to commence.

CITY OF SACO WATER RESOURE RECOVERY DEPARTMENT

The City of Saco has sewer system within the limits of this Project which includes approximately 3 manholes that will require adjustment.

The City plans to perform these adjustments and estimates 2 Working Days to lower and plate the manholes during reconstruction and milling operations. They will also require two (2)

working days to set the manholes to grade prior to surface pavement. The contractor shall notify the City two weeks prior to any work required by the City.

The contractor shall notify the City ten (10) working days prior to the utility coordination meeting. The coordination effort is to relay contractor's construction schedule.

MAINE TURNPIKE AUTHORITY

The Authority has existing lighting facilities located within the existing Hotel and Conference Center ramps and the Exit 36 Interchange ramps. All existing lights shall be maintained during construction.

SEE POLE LIST ON FOLLOWING PAGE FOR ADDITIONAL INFORMATION

Exit 35 & 36 Saco Interchange Improvements Utility Pole List & Information

Prepared By: Stantec Consulting Services
Prepared For: Maine Turnpike Authority
Contract: 2022.07
Date: 8/30/2022

Route 112

Existing Pole Information					Proposed Pole Information					
Description	**Station**	**Left**	**Right**	**Offset**	**Station**	**Left**	**Right**	**Offset**	**Remarks**	**Utility Responsible**
NET&T #80	144+35.00	x		48	144+35.00	x		48	Adjust height of pole to increase clearance for new overhead service (approx 5' adjustment)	Central Maine Power
NET&T #83S	144+43.00		x	47	144+43.00		x	47	Add service crossing and drop to pole for new underground for SB Admin Building	Central Maine Power
NET&T #79 (has drop for telecom crossing on bridge)	145+88.00	x		64	145+88.00	x		64	Adjust height of pole to increase clearance for new ramp (approx 10' to 15' adjustment)	Consolidated Communications
NET&T #78	148+07.00	x		88	148+07.00	x		60	set new pole to increase clearance for new ramp	Consolidated Communications
NET&T #77 (has drop for Telecom crossing on bridge)	151+75.00	x		128					existing pole to remain	
NET&T #76	154+71.00	x		88					existing pole to remain	
NET&T #75	156+08.00	x		64					existing pole to remain	
NET&T #74	157+42.00	x		45					existing pole to remain, new aerial service from this pole	
NET&T #73S					157+77.00	x		41	new midspan pole for relocated aerial service for Ramada Inn	Central Maine Power
NET&T #73	158+86.00	x		28	158+86.00	x		37	set new pole outside clearzone	Consolidated Communications
NET&T # J72	160+23.00		x	26	160+23.00		x	30		Consolidated Communications
NET&T #J71.5	161+83.00		x	23	161+89.00		x	30		Consolidated Communications
NET&T #j71	163+40.00		x	23	163+40.00		x	31		Consolidated Communications
CMP # 70 (#2170 Bell Atlantic)	164+23.00		x	23	164+24.00		x	33	Remove Existing Drop for Ramada Inn and replace with new drop for NB Admin Building	Consolidated Communications
NET&T #69	165+73.00		x	30	165+76.00		x	39		Consolidated Communications

Lund Road

Existing Pole Information					Proposed Pole Information					
Description	**Station**	**Left**	**Right**	**Offset**	**Station**	**Left**	**Right**	**Offset**	**Remarks**	**Utility Responsible**
NET&T #01	071+29.00		x	18	071+29.00		x	18	Adjust height of pole to increase clearance for new Traffic Signals (approx 10' adjustment)	Consolidated Communications

NB Access Road

Existing Pole Information					Proposed Pole Information					
Description	**Station**	**Left**	**Right**	**Offset**	**Station**	**Left**	**Right**	**Offset**	**Remarks**	**Utility Responsible**
NET&T #73S					29+57.00	x		47	New pole for relocation of private Ramada Inn services, install drop for electric and comm	Central Maine Power

104.4.7 Cooperation With Other Contractors

This Subsection is amended by the addition of the following:

Adjacent contracts currently scheduled for the 2022-2025 construction seasons include:

MTA Contract 2022.02 – Exit 36 Improvements and Pavement Rehabilitation MM 35.5 to MM 34.9 & Culvert Outlet Ditching MM 34.9

City of Saco – Sewer Force Main Replacement

City of Saco – Jenkins Road Intersection Improvements

The following Subsection is added:

104.5.1 shall be deleted in its entirety and replaced with:

104.5.1 Limits on Subcontracting

The Contractor shall perform at least 20% of the value of the Work with its own Work force, excluding any specialty items as designated in the contract documents by the Authority.

The Contractor shall not carry the Workers of another Contractor or firm on its payroll or a Subcontractor's payroll. The Contractor shall not use any Subcontractors that are debarred from Bidding by Federal Government or any agency of the State of Maine.

105.2.4.3 Asbestos

The Contractor shall note that the existing structure(s) has/have tested negative for asbestos containing materials. A copy of the Asbestos Determination Report is attached as **Appendix A**.

Whereas no Asbestos Containing Material Determination Survey is 100 percent accurate, building demolition activities shall be accomplished under the supervision of a "competent person", as defined by OSHA, to evaluate whether materials uncovered/exposed are asbestos containing materials. If the "competent person" observes, or believes he has observed, asbestos containing materials while demolition is underway, the "competent person" shall immediately stop the demolition, secure the site and notify the Project Resident/Inspector.

The Owner shall have the area tested for asbestos containing materials. No work will be permitted in the area until samples show that no asbestos containing materials exists, or if asbestos containing materials are present, the conditions are abated. Compensation for delays resulting from stopping the demolition, testing for asbestos containing materials, and abating asbestos containing materials, if they exist, shall be limited to a time extension.

105.8.2 Permit Requirements

The Project is being constructed under the following Maine Department of Environmental Protection (DEP) Permits:

- Natural Resources Protection Act Individual Permit;
- Maine Construction General Permit.

A copy of Maine DEP permits issued for this contract and associated conditions and compliance standards are attached in Appendix G. The Contractor is responsible for executing all work under this contract in accordance with these Maine DEP permits.

The Project has been authorized under Section 404 of the Clean Water Act, through the US Army Corps of Engineers Individual Permit. A copy of the project-specific authorization, conditions, and Army Corps of Engineers Individual Permit is provided in Appendix H. A signed copy of the Start Work Notification Form must be sent to the Army Corps Maine Project Office at least two weeks before work commences. The Contractor is responsible for executing all work under this contract in accordance with the U.S. Army Corps of Engineers permit.

The Project is subject to the Stormwater Memorandum of Agreement for Stormwater Management Between the Maine Department of Transportation, Maine Turnpike Authority, and Maine Department of Environmental Protection (Stormwater MOA). Under the Stormwater MOA, all MTA construction, operation, and maintenance activities are subject to Maine Stormwater Law Basic Standards through implementation of MaineDOT's Best Management Practices for Erosion and Sedimentation Control (MaineDOT BMP Manual), which are the Contractor's responsibility to implement. Under the Stormwater MOA, certain projects may also require the construction of permanent post-construction stormwater management BMPs, as specified in the plan set to this project where applicable.

The Project is subject to the requirements of the Maine Pollutant Discharge Elimination System (MPDES) General Permit for Stormwater Discharge from Construction Activity (Maine Construction General Permit), as promulgated by the US Environmental Protection Agency (US EPA) and Administrated by the Maine Department of Environmental Protection (DEP).

A project-specific Notice of Intent (NOI), accompanied by a preliminary Limit of Disturbance (LOD) plan, or an annual consolidated NOI for all MTA project construction activities, was submitted by the Authority to the DEP for coverage under the Maine Construction General Permit (MCGP). Compliance with the erosion and sedimentation control requirements outlined in this Contract is required by the Contractor.

The Contractor shall prepare a LOD plan illustrating the Contractor's proposed limit of earthwork disturbance. The LOD plan shall show all construction access locations, field office locations, material and temporary waste storage locations, as well as include the Contract limits of earthwork disturbance. All applicable erosion and sedimentation control devices needed shall be detailed on the Contractor's LOD plan and are not limited to those devices shown on the Contract LOD plan. **This Plan shall be submitted for review and approval, to the Resident within 14 days of Contract award.** Payment for creating, revising, and completing this plan shall be incidental to Item 659.10, Mobilization.

The LOD for this Contract has been estimated to be 48.07 acres.

At any time during the Contract, if the Limit of Disturbance needs to be adjusted to accommodate construction activities, the Contractor shall resubmit the LOD plan (including any

additional erosion and sedimentation control measures needed) to the Resident for review and approval prior to any additional disturbance taking place:

- The Resident shall have a minimum of five (5) working days to approve the revised LOD plan.
- For contracts with a project-specific NOI, if the cumulative area of disturbance exceeds the estimated LOD noted above, the Resident shall first approve of the plan and then possibly resubmit the NOI to Maine DEP for approval. The approval may take a minimum of 14 working days from the date of submittal to Maine DEP.

Compliance with the erosion and sedimentation control requirements outlined in this Contract is required by the Contractor.

The Contractor shall comply with the conditions and compliance standards outlined in the Army Corps Section 404 Individual Permit, Maine DEP NRPA Individual Permit, Site Location of Development Act General Permit, the Stormwater MOA, and the Maine Construction General Permit. The Contractor shall indemnify and hold harmless the Maine Turnpike Authority or its agents, representatives and employees against any and all claims, liabilities or fines arising from or based on the violation of the above noted permits.

This Project is also subject to the requirements of the Maine Pollutant Discharge and Elimination System (MPDES) General Permit for the Discharge of Stormwater from MTA's Municipal Separate Storm Sewer Systems (MS4), because it is located within an Urbanized Area (UA) as defined by the 2010 census by the U.S. Bureau of the Census. MS4 compliance requires all Contractors to be properly trained in Erosion and Sedimentation Control (ESC) measures (as per Special Provision Subsections 105.8.1 and 656.07) and implement measures to reduce pollutants in stormwater runoff from construction activities.

105.11 As-built Plans

The contractor shall provide the Authority with as-built plans in PDF and MicroStation, or other approved CADD formats. The as-built plans shall note changes to the bid documents, including, but not limited to pavement, concrete, barrier, guardrail, culverts, drainage, foundations, wiring, signs, etc. The as-builts plans shall also provide GPS accurate locations of all underground work. Submittal of Draft, Final Draft, and 100% as-built plans to the Resident shall be conditions of Mobilization payment, Retainage Reduction, and Final Payment as noted in Special Provision 108.

105.11.1 As-Built Plan Submittals

The Contractor shall make the following submittals of as-built plans to the Resident as part of the conditions of Mobilization payment, Retainage Reduction, and Final Payment as noted in Special Provision 108:

a. Draft As-built Plans containing any underground work completed within the prior 30 pay period once 50% of the Work is complete.
b. Final Draft As-Built Plans containing all underground work
c. 100% As-Built Plans containing all underground work and changes

105.11.2 As-Built Plan Requirements

As-built plans and CADD files shall conform to the following requirements:

a. Include legend of line weights and styles
b. Project stationing shall be on its on layer and be color white
c. Changes to pavement, concrete, barrier guardrail, foundations, signs etc. shall be on their own layer and be color brown
d. Electric power lines, cable, conduit, and lighting cables shall be on their own layer and be color red
e. Gas, oil, steam, petroleum, or gaseous materials shall be on their own layer and be color yellow
f. Communication, Alarm or signal lines, cables, or conduit shall be on their own level and be color orange
g. Potable water shall be on its own layer and be color blue
h. Sewers and drain lines shall be on their own layer and be color green
i. Reclaimed water, irrigation, and slurry lines shall be on their own level and be color purple.

107.1 Contract Time and Contract Completion Date

This Subsection is amended by the addition of the following:

All work shall be completed on or before November 21, 2025. The construction of Exit 35 shall be substantially complete by October 24, 2025.

107.1.1 Substantial Completion

This Subsection is amended by the addition of the following:

Substantially complete shall be defined by the Authority as the following:

- All work is complete except punch list items

Supplemental Liquidated damages on a calendar day basis in accordance with Subsection 107.8 shall be assessed for each calendar day that substantial completion is not achieved.

107.3.2 Night Work

This Subsection is amended by the addition of the following:

Nightwork will be allowed within the limitations defined in Section 652. The Contractor shall formally notify the Resident of their intent to perform night work a minimum of 14 calendar days ahead of the planned nightwork.

107.3.3 Sundays and Holidays

This Subsection is amended by the addition of the following:

Sunday work operations will be allowed within the limitations defined in Section 652. The Contractor shall formally notify the Resident of their intent to work on a Sunday a minimum of 14 calendar days ahead of the planned Sunday work.

107.4.6 Prosecution of Work

The contractor shall be allowed a maximum combined total of 15 nights of single night closures at Exit 36 SB on ramp (7 nights), Exit 36 SB off ramp (4 nights), and Exit 36 NB off ramp (4 nights) to complete the Exit 36 improvements. Two ramps may be closed simultaneously only if work is occurring on both ramps. Ramp closure(s) will not be allowed over a weekend or holidays unless otherwise approved by the Resident. All Ramp closures shall occur before June 15th or after Labor Day Weekend.

The following activities must be completed by the date specified:

- The preload embankment and have all instrumentation initialized and operational by the Interim Completion Date of May 26, 2023.
- All clearing must be completed prior to June 1, 2023.
- Hotel Access Road shall be constructed to subgrade by July 1, 2023.
- Soil nail wall construction shall be completed by October 18, 2024
- The construction of all stream work shall be completed between June 1st and September 30th.

Supplemental Liquidated damages on a calendar day basis in accordance with subsection 107.8 shall be assessed for each calendar day that each of these completion dates are not achieved or each additional night of ramp closures beyond the maximum individual and total number specified above.

The Authority will utilize 348 North Street for the field office. The Contractor will remove this building at the end of the project. The Contractor shall disconnect utilities at their respective mains in accordance with SP 202 prior to placing any pavement on Route 112. The Contractor shall provide a minimum of 30 days notice to the Resident prior to anticipated utility disconnection.

The Contractor shall submit to the Authority a construction schedule which shall document that the Contractor has the necessary labor and equipment to work immediately and continuously at the project site. The intent of this specification is to minimize the amount of time for construction, while providing the Contractor sufficient time to complete the work in a diligent manner as prescribed by the project's Substantial Completion date.

Traffic signals shall be set to flashing for two weeks prior to the signal becoming fully operational, when the new interchange opens to traffic.

107.4.7 Limitations of Operations

Toll plazas shall become operational at midnight of the day they are opened to traffic.

The contractor shall maintain two-way paved access to the Ramada Inn from Route 112 at all times. The contractor shall notify the resident a minimum of 30 days prior to the requested closure of the Hotel & Conference Center Ramps. The Hotel & Conference Center Ramps may not be closed until work commences on the Exit 35 ramps. The existing hotel entrance at the intersection of Route 112 and Lund Road shall not be closed until the proposed Hotel Access Road is paved to binder and open to traffic.

Surface paving of new lanes adjacent to mainline milling shall not be placed until the milled areas are paved (filled in).

The construction in each location shall proceed expeditiously. Once a ramp or bound of the Maine Turnpike is milled it shall be paved (filled in) within two weeks.

Temporary bituminous ramps will be required at the ends of each milled lane.

The contractor shall not run pavers, rollers, or other heavy equipment over the toll slabs and shall protect them from tracking of tack coat.

Traffic will be allowed to traverse the longitudinal joint between surface pavement and milled lanes where the pavement is lower in one lane than the adjacent lane only when a safety edge is used.

The contractor shall complete the excavation, drainage, subbase, pavement, toll booths, concrete slabs, and electrical work associated with the Exit 35 Northbound and Southbound toll plazas in a condition suitable for commissioning and testing of the toll lanes by the System Integrator and Authority. The electrical systems associated with the two Administration buildings shall be complete prior to beginning the testing and commissioning of the toll lanes, including all interconnect fiber cables. The System Integrator shall commence commissioning testing once the cash lanes are in a suitable condition and complete the testing no later than 14 calendar days for each toll lane. The commissioning and testing on the Northbound and Southbound lanes will be done separately to facilitate the construction schedule.

Due to the presence of marine deposits, material stockpiles will be limited to a height of 15 feet on the project site to minimize the potential for slope instability without prior approval by the Engineer. The Contractor shall spread materials delivered for embankment construction as they arrive on site.

Completion of the preload waiting period will be determined by the Engineer based on the collection and evaluation of instrumentation data. No construction activities will be allowed during the first five months of the waiting period. After the first five months of the waiting period the Contractor may install piles, but no other construction shall occur until the completion of the waiting period, which is anticipated to be six months. The contractor shall consider the duration of the waiting period in the development of their bid and sequencing of the work.

Care shall be taken when working near catch basins to ensure foreign material and contaminants do not enter the basin. If foreign material and/or contaminants enter the basin, it shall be removed prior to the material exiting the basin into a waterway. Removal shall be completed to the satisfaction of the Resident and payment shall be incidental to the Contract.

The Contractor shall submit their proposed staging and storage areas for approval by the Authority. All stored equipment must be outside of the clear zone. Proposed equipment storage locations shall be selected based on (1) proximity to Urban Impaired Streams / Protected Natural Resources; (2) minimizing rutting or other actions that may hinder sheet flow from roadway; and (3) spill control and prevention, in the event of a fluid release from the equipment.

The Contractor shall complete the work as shown on the phasing and maintenance of traffic plans. Modifications to the phasing or associated maintenance of traffic plans will not be permitted unless submitted in writing a minimum of 14 days prior to anticipated implementation, including detailed plans, and approved by the Authority.

All roadway lanes, ramps, bridges and driveways shall remain open at all times and in accordance with the restrictions of Special Provision 652 unless otherwise noted herein or approved by the Authority.

Ramps shall not be closed on holidays.

The Contractor shall progress the work in a manner that minimizes disruption to the public to the extent practical.

The Contractor shall secure all catch basin grates with Sikaflex 1a or approved equal before being allowed to shift traffic onto the shoulder.

Existing lighting at the Hotel Northbound On Ramp shall be maintained and operational until the proposed high mast light at Exit 36 Northbound Off Ramp is installed and operational.

Long-term shoulder closures and lane shifts along I-95 mainline shall only be used during periods of construction activity. During periods of inactivity (periods of inactivity are considered to be greater than two weeks), the Contractor shall remove the lane shifts or shoulder closures and relocate the temporary barrier and other maintenance of traffic devices to reestablish normal traffic conditions.

Wide loads will be allowed to pass through the Project area on the Maine Turnpike during daylight hours as authorized by the Authority. Wide loads are restricted from moving on the Turnpike from a half hour after sunset until a half hour before sunrise. Wide loads must be able to safely pass all daytime work areas. Wide loads will not be permitted to pass through the Project area on Route 112 during bridge wearing surface replacement. The wide load lane may be closed when wide loads are not permitted on the Turnpike by the Authority. The temporary wide load lane closures must be scheduled one week in advance and occur outside of the various Holiday restrictions.

Between November 15th and April 1st the Contractor shall provide, at a minimum, 4’-0” inside shoulders and 8’-0” outside shoulders along the Maine Turnpike mainline and ramps.

30 days prior and again 14 days prior to placing maintenance of traffic devices and narrowing the Exit 36 ramps for each construction season, the Contractor shall notify the following businesses to allow adjustments in oversize permit applications:

- Casco Bay Steel – Brian Tupper – (207) 415-4787
- Casco Bay Transportation – Rick Bryan – (207) 710-2323
- Wood Structures (Boise Cascade) – Shawn Palardy – (877) 291-5276

There shall be no pile driving during non-daylight hours. Pile driving will not be allowed within 10 feet of traffic.

Any required pump closures for pumps 6, 8, and 10 at the gas station at 337 North Street shall occur between hours of 9:00 p.m. and 6:00 a.m. and shall be coordinated with the Resident in writing a minimum of 14 calendar days prior to the requested closures.

107.6 Completion Incentives and Disincentives

This Contract will include Completion Incentives of $1,000 per Calendar Day for each night of ramp closures less than the maximum number specified in subsection 107.4.6 Prosecution of Work. The Contract will include Completion Disincentives of $1,000 per Calendar Day for each night of ramp closures beyond the maximum number specified in subsection 107.4.6 Prosecution of Work. Disincentives are separate and distinct from the Liquidated Damages and Supplemental Liquidated Damages.

107.8.1 Fabrication Time.

The Authority has budgeted for the following amounts of continuous full time fabrication/shop inspection for certain Work components:

Element	Time	Supplemental LD
1) Toll Canopy Structural Steel	28 calendar days	$500 per calendar day

The Contractor is responsible for requiring their fabricators and suppliers to produce these products for the Work continuously until finished, including any needed actions to correct unacceptable workmanship or materials. If the Authority determines that shop inspection beyond these times is required, then the corresponding Supplemental Liquidated Damages will be deducted as they occur from the amounts otherwise due the Contractor. The Contractor will be notified by the Department when these times begin and when the allotted time will expire.

If a fabricator or supplier works more than one shift per day and the Authority determines that inspection is required for each shift, each shift will count as a calendar day and the LD rate will be the noted amount per shift per calendar day in lieu of per calendar day.

Inspection is required for the following activities:

For metal fabrication work – welding, including tack welding, heat correcting, nondestructive examination, assembly verification.

108.2.3 Mobilization Payment

The second paragraph is deleted in its entirety and replaced with the following:

Upon approval of all pre-construction submittals required for approval by this Contract, including those listed in Section 104.4.2 – Preconstruction Conference, the Contractor will receive payment of 50% of the Lump Sum price for Mobilization, not to exceed 5% of the Bid less the amount bid for Mobilization. After the Authority determines that the Work is 50% complete and the Contractor has submitted a Draft (50%) as-built submittal of all underground work to date (within the prior 30 day pay period) as defined in Special Provision 105., the Contractor will receive the other 50% of the Lump Sum price for Mobilization, not to exceed 5% of the Bid less the amount bid for Mobilization. Any remaining Mobilization will be paid upon Final Acceptance.

108.3 Retainage

The seventh paragraph is deleted in its entirety and replaced with the following:

When requested by the Contractor an 80 percent reduction of retainage will be considered by the Authority when the Project is substantially complete and the Contractor has submitted a Final Draft (98%) as-built submittal of all underground work, in accordance with Special Provision 105. When requesting a reduction, the Contractor shall include an explanation of the outstanding Work, and estimate of the cost to complete the Work, and a schedule for completing the Work. Seasonal limitations as well as warranty and establishment periods (for vegetation) shall be addressed.

108.4.2 Price Adjustment for Diesel Fuel

A price adjustment for diesel fuel will be made for the listed items.

Price adjustments will be based on the variance in costs for diesel fuel. They will be determined as follows:

The quantity of listed items, for each pay item will be multiplied by the diesel factor times the difference in price in excess of 5 percent between the base price and the period price of diesel fuel. Adjustments will be made upward or downward, as prices increase or decrease.

Covered Items:

Pay Item	Item Description	Diesel Factor (Gal/Unit)
203.20	Common Excavation	0.33G/CY
203.25	Granular Borrow	0.48G/CY
304.10	ASCG	0.46G/CY
304.14	Type A	0.46G/CY
403.207	19mm HMA	2.75G/T
403.2072	19mm Asphalt Rich Base	2.75G/T
403.208	12.5mm HMA	2.75G/T
403.2081	12.5mm Polymer HMA	2.75G/T
403.209	9.5mm HMA Incidentals	2.75G/T

403.211	9.5mm HMA Shim	2.75G/T
403.213	12.5mm HMA	2.75G/T
615.07	Loam	0.48G/CY

Quantity: The quantity of each item will be determined from the quantity shown on the progress estimate for each pay period.

Base Price: The base price of diesel fuel to be used in the price per gallon current with the **bid opening date**. This price is determined by using the weekly retail diesel price for the New England area, as listed on the Energy Information Administration's webpage.

Period Price: The period price of diesel fuel will be determined by the Department by using the weekly retail diesel price for the New England area, as listed on the Energy Information Administration's webpage current with the pay period ending date of the progress estimate.

108.5 Right to Withhold Payments

Add the following:

O. Failure to provide appropriate superintendence as defined in Section 104.3.4.

108.8 Final Payment

The first paragraph is deleted in its entirety and replaced with the following:

Following conditional acceptance of the physical Work under subsection 107.9.3, and submission of 100% As-built plans to the Resident, in accordance with Special Provision 105, the Authority will prepare a final Invoice reflecting final quantities of the items of Work performed. The Authority may require the Contractor to provide information necessary to substantiate Pay Items, including Statements itemizing Force Account Work. The Authority will make final payment upon approval of the Authority's board, in the amount of the Work done, less all previous payments and all amounts to be retained or deducted under the provisions of the Contract. For a related provision, see Section 107.9.5 – Final Acceptance.

SPECIAL PROVISION

SECTION 202

REMOVING STRUCTURES AND OBSTRUCTIONS

(Removing Pavement Surface)

202.01 Description

The following sentences are added:

This work shall also consist of removing the surface of the bituminous concrete pavement in all locations to the depth, width, grade, and cross section as shown on the Plans or as directed by the Resident.

Removal of the pavement and membrane surface from the bridge decks shall be completed by scraping or other methods that will not damage the existing concrete deck surface. Milling of bridge deck pavement shall not be allowed.

Removal of approach pavement shall be completed using a milling machine meeting the requirements in the first two paragraphs of section 202.061.

Areas requiring shim pavement to reach final pavement grade shall not be milled.

This work shall also consist of construction of temporary ramps at all butt joints as shown in the MaineDOT Standard Details, March 2020 Edition – Pavement Overlay Butt Joint Detail (Roadways), Page 202(01) or as approved by the Resident. The length of the temporary ramp shall be at least 1/2 L.

The following subsection is added:

202.032 Removing Bridge Pavement Surface and Membrane

All bridge deck pavement, membrane and scrapings shall be disposed of by the Contractor off of the turnpike right-of-way in accordance with the Maine Department of Environmental Protection Solid Waste Management Requirements.

The following paragraph is added:

Extreme care shall be taken to avoid damaging the existing concrete or bituminous pavement intended to remain. All existing bituminous pavement and bridge deck concrete, intended to remain, damaged by the Contractor's removal operations shall be repaired by the Contractor as approved by the Resident at no additional cost to the Authority.

202.061 Removing Pavement Surface

This Subsection is deleted and replaced with the following:

The equipment for removing the bituminous surface, excluding bridge decks, shall be a power-operated milling machine or grinder capable of removing the bituminous concrete pavement to the required depth, transverse cross slope, and profile grade using an automated grade and slope control system. The controls shall automatically increase or decrease the pavement removal depth as required, and readily maintain desired cross slope to compensate for surface irregularities in the existing pavement course. The milling machine shall accurately establish profile grades by referencing from a fixed point such as a 30-foot minimum contact ski (floating beam), 24-foot non-contact ski (floating beam) with 3 or more sensors; or 3 non-contact sensors directly affixed to the fore, mid, and aft points of the milling machine. Systems designed to incorporate a contact sensor located at the mid-point of the milling machine in lieu of a non-contact sensor in conjunction with non-contact sensors at the fore and aft points will be permitted. Grade control sensors shall all be located on the same side. A single sensor, contact or otherwise, shall not be permitted. A copy of the automation operations manual shall be provided to the resident upon request. The equipment shall also have an effective means for removing excess material from the surface and preventing flying material in compliance with Subsections 105.2.5 Compliance with Health and Safety Laws and 105.2.6 Convenience of the Public, of the Specification.

The rotary drum on the machine shall be a minimum of 7 feet in width and utilize carbide tipped tools at a maximum 8mm tooth spacing pattern and a minimum triple wrap configuration. The difference in height from the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed ¼ inch. The carbide tipped tools on the rotary drum shall be continually maintained and shall be replaced as warranted to provide a uniform milled pavement texture. The forward operating speed shall be limited to a maximum speed of 50 feet per minute (fpm). The limited speed is not to be calculated on an average basis over time but shall be the actual limitation at any moment during the milling operation.

The track pads that the machine travel on shall all be of a uniform thickness equal to or exceeding the manufacturers recommendations. A copy of the manufacturer's recommendations shall be provided to the resident upon request.

The Contractor shall locate, identify and remove all objects in the pavement through the work area that would be detrimental to the milling machine.

The Contractor shall be responsible for the layout of the longitudinal centerline along the crown line. The contractor shall layout the site prior to any milling. Layout shall be achieved by physical measurements obtained every 50' along the length to be milled from a fixed reference point. The contractor shall transfer the measurements to the pavement surface every 50' and apply a paint mark at each location. The marks shall then be connected by a smoothed string line and subsequent paint marks applied along the string at no greater than 10' intervals. The Resident will inspect the layout line before milling activities may begin.

The finished milled surface will be inspected before being accepted, and any deviations in the profile exceeding 3/8 inch under a 16-foot string line or straightedge placed parallel to the centerline will be corrected. Any deviations in the cross slope that exceed 3/8 inch under a 12-foot string line or straightedge placed transversely to the centerline will be corrected. In no case shall

the cross slope in a single lane width be inverted resulting in a depression as measured transverse to the direction of travel. Any cross slope inversions or depressions shall be corrected by spot shimming the area with HMA as directed by the resident prior to installing any leveling or wearing course. Any areas requiring corrections will be subject to the same acceptable surface tolerances. These corrections shall be done with no additional expense to the Authority. Excess material that becomes bonded to the milled surface shall be removed to the Resident's satisfaction before the area is accepted.

If a milled safety wedge is required by the contract, it shall not be removed any sooner than 24 hours prior to paving. In no case will a vertical milled edge be permitted over a weekend or holiday. The contractor shall schedule the wedge removal accordingly.

The Contractor shall deliver the cubic yards of pavement grindings as specified below to the following Maintenance Facilities. The exact location of the stockpile shall be as directed by the Resident.

Name of Facility	Mile Marker	Cubic Yards
Kennebunk Maintenance Facility	25.3	500 CY

All surplus pavement grindings, except for the amount specified above, shall be disposed of by the Contractor off the turnpike right-of-way. All grindings shall be disposed of in accordance with the Maine Department of Environmental Protection Solid Waste Management Requirements.

202.07 Method of Measurement

The removal of existing bituminous concrete pavement will be measured by the square yard of material removed to the required depth.

The following sentences are added:

Transporting and stockpiling of the pavement grindings at the maintenance facilities will not be measured separately for payment, but shall be incidental to the Removing Pavement Surface items.

Installation of temporary bituminous ramps will not be measured separately for payment, but shall be incidental to the Contract.

Removal of temporary bituminous ramps will not be measured separately for payment, but shall be incidental to the Contract.

Installation of and removal of longitudinal safety wedges will not be measured separately for payment, but shall be incidental to the Contract.

SPECIAL PROVISION

SECTION 202

REMOVING STRUCTURES AND OBSTRUCTIONS

(Removing Asbestos Containing Materials)
(Removing Buildings)

202.01 Description

The following paragraphs are added:

All non-asbestos containing materials shall become the property of the Contractor and shall be removed from the site prior to the completion of the Project. The Contractor shall provide the Resident with an affidavit stating the final location of all disposed material and that the material was disposed of in accordance with the Maine Department of Environmental Protection Solid Waste Regulations.

202.02 Removing Buildings

The following paragraphs are added:

The foundations, including floor slabs, shall be completely removed. Concrete shall be disposed of off-site. The cellar hole shall then be filled to surrounding levels as required under the provisions regarding excavations below.

All steps, walks, slabs, piers, posts, decks, and associated debris shall be completely removed.

Excavations shall be filled to ground level with two foot layers of common borrow that meets the requirements of Subsection 703.18 of the Standard Specifications except in locations that are designated to receive special fill material, such as under proposed footings, concrete slabs and pavement. In this process, the contour and grades of site plan and sections are to be followed.

All buildings and materials contained therein and any items connected with the property of a personal property nature shall become the property of the Contractor and shall be completely removed from the 348 North Street Property. Ownership of the buildings reverts to the Contractor upon the Notice to Proceed issued by the Maine Turnpike Authority. All debris and unusable materials shall be removed to an approved transfer station or approved landfill. Under no circumstances shall any material or debris be disposed of by burning on the premises nor shall the debris be burned at an off-premise site.

The Contractor shall provide and maintain all temporary barricades, signs or other safety measures necessary.

The Contractor shall remove all utility service connections to the utility main prior to demolition of the buildings. All existing sewer connections shall be cutoff and sealed with a water and gas tight seal to the satisfaction of the Authority's Engineer before such connections are

covered by any fill material. Water connections or services shall be cut and completely capped or plugged in a manner to prevent any flow or seepage of water into any excavated area.

The Contractor shall obtain any and all permits or licenses necessary for the performance of the work and shall familiarize himself with and conform to all local, State and Federal laws, regulations or ordinances applicable to the work.

The following Subsection is added:

202.021 Removing Asbestos Containing Materials

The Maine Turnpike Authority had an Asbestos Demolition/Renovation Impact Survey performed at 348 North Street, Saco, Maine in June 2022. The Asbestos Demolition/Renovation Impact Survey is attached in **Appendix A** - Asbestos Demolition/Renovation Impact Survey, dated June 2022.

The asbestos determination investigation did not include demolition of the structure or equipment to locate asbestos containing materials and indicated that the structure has no regulated asbestos containing building materials. Should additional suspect asbestos containing materials be observed during the demolition process, the provisions of Special Provision Subsection 105.2.4.5 shall apply.

The General Contractor or building demolition Contractor may sub-contract the removal of the asbestos containing material (ACM) to a licensed asbestos abatement Contractor or use his own trained and licensed personnel. The licensed asbestos abatement Contractor must prepare a work plan for the removal of the ACM and submit a copy to the Resident for approval prior to commencing with the removal of ACM.

Disposal of all ACM shall comply with current EPA and Maine DEP regulations. The Contractor shall submit to the Resident the original disposal receipts acknowledging proper disposal of ACM prior to the payment of Removing Asbestos Containing Material pay items.

202.05 Method of Measurement

The first and third sentences of the first paragraph are deleted and replaced with the following:

Removing the buildings will be measured as one lump sum per building.

202.06 Basis of Payment

This Subsection is amended by the addition of the following:

Removing Buildings will be paid for at the Contract lump sum price per building which price shall be full compensation for the legal removal and disposal of all building materials, including removal of reinforced concrete walls and foundations, termination of utilities, removing and stacking of equipment and items, and shall include all materials, labor, tools and equipment necessary to complete this work. Payment also includes removal of all utilities to their respective

main and capping, plugging, and sealing the main. No additional payment will be made for handling or disposal of any asbestos containing material found during building removal.

SPECIAL PROVISION

SECTION 202

REMOVING STRUCTURES AND OBSTRUCTIONS

(Rumble Strips)

202.01 Description

The following sentences are added after the first paragraph:

This work shall consist of cutting a pattern of rumble strips on the northbound and southbound roadways at the locations shown on the Plans. Rumble strips shall not be placed across ramp openings or on bridges.

The following Subsections are added:

202.065 Rumble Strips

The rumble strips shall not be cut until the Contractor has placed the permanent pavement markings at the required locations.

At proposed rumble strip locations, the bituminous concrete paved surface shall be removed by milling in strips as detailed on the Plans and as directed by the Resident. The pattern will be 80 feet of rumble strips followed by a 20 foot space repeated along the entire length on the outside shoulder. The inside shoulder shall be continuous. The rumble strips shall be normal to the baseline of the roadway on tangent sections and radial on curves. The Contractor shall be responsible for the layout of the rumble strips. The milling machines for this type of rumble strip are designed by:

Surface Preparation Technology
81 Texaco Road
Mechanicsburg, PA 17055
Tel. (717) 697-1450

L&C Flashing Barricades
60 Walpole Street
Canton, MA 02021
Tel. (508) 580-6700

Thomas Grinding
110 Fox Lane Southwest
Moore Haven, FL 33471
Tel. (863) 946-1461

The milling machine shall be equipped with a 20 foot pointer to provide longitudinal grade control.

202.07 Method of Measurement

The following paragraph is added:

Rumble Strips will be measured by the actual number cut, completed and accepted.

Layout of rumble strips, disposal of milled bituminous pavement and roadway cleanup will not be measured separately for payment, but shall be incidental to this item.

202.08 Basis of Payment

The following sentences are added:

Rumble Strips will be paid for at the Contract unit price per each, which price shall be full compensation for all labor, materials, equipment and incidental items of work for a complete installation.

Payment will be made under:

Pay Item		Pay Unit
202.205	Rumble Strips	Each

SPECIAL PROVISION

SECTION 202

REMOVING STRUCTURES AND OBSTRUCTIONS

(Removing Rumble Strips)

202.01 Description

The following paragraph is added:

This work shall consist of grinding existing rumble strip locations to a depth of 1-1/2 inches, coating vertical and horizontal surfaces with bituminous tack coat, and installing 1-1/2 inches of hot mix asphalt, 9.5 mm over the entire milled area. Locations and lengths of removal shall be as shown on the Plans or as approved by the Resident.

The following Subsections are added:

202.011 Materials

Grinding shall be done in accordance with Section 202. Bituminous tack coat shall conform to Section 409.

Hot mix asphalt, 9.5 mm shall conform to Section 401.

202.025 General

Existing rumble strips are approximately 16 inches long, seven inches wide, 1/2 inch deep, and spaced approximately every five inches.

202.07 Method of Measurement

The following paragraph is added:

Removing Rumble Strips shall be measured by the linear foot removed and accepted. Measurement shall be parallel to the baseline.

202.08 Basis of Payment

The following sentences are added:

Removing Rumble Strips shall be paid for at the Contract unit price per linear foot which includes all grinding, bituminous tack coat, pavement, equipment and labor necessary to satisfactorily complete the work.

Payment will be made under:

Pay Item		Pay Unit
202.206	Removing Rumble Strips	Linear Foot

SPECIAL PROVISION

SECTION 203

EXCAVATION AND EMBANKMENT

203.01 Description

The following paragraph is added:

This work shall consist of cutting, removing and disposing of the full depth of existing bituminous concrete pavement at the approaches to the bridge structures within the limits of work as shown on the Plans or as approved by the Resident. The pavement shall be sawcut to the full depth of pavement at the limits of the excavation to provide a clean, vertical cut surface.

203.04 General

The following sentence is added to the end of the third paragraph.

There are no approved waste storage areas or waste areas within the Project limits unless shown on the Plans. Unsuitable materials shall be disposed of off-site in accordance with Subsection 203.06.

All excavations shall be accomplished in accordance with the applicable OSHA Standards. The Resident reserves the right to request the Contractor to prepare an excavation plan. This plan shall include, but not necessarily be limited to, the limit and depth of excavation, side slope, shoring, trench box and utility support.

203.10 Embankment Construction - General

The thirteenth and fourteenth paragraphs are deleted and replaced with the following:

All portions of the embankment shall be compacted in accordance with the designated embankment compaction requirements specified for the Project.

The existing slopes should be benched as shown on the drawings prior to placing additional fill. Embankment fill should be placed in lifts which extend laterally beyond the limits of the design side slopes such that the specified degree of compaction is achieved within the limits of the completed embankment. The slopes should then be trimmed back to design dimensions.

203.16 Winter Construction of Embankments

The word “core” is deleted from the first and second sentences in the first paragraph.

203.18 Method of Measurement

The following paragraphs are added:

There will be no additional payment for the required excavation plan, and costs shall be incidental to the Excavation items.

SPECIAL PROVISION

SECTION 203

EXCAVATION AND EMBANKMENT

(Contaminated Soil and Groundwater Management)

203.01 General.

The work under this specification shall be performed in conformance with all the procedures and requirements described herein for the following activities: contaminated soil handling, reuse, temporary stockpiling, transportation, storage, and disposal and contaminated water handling, storage, treatment, and disposal. This specification also addresses contaminated soil location, identification, and classification. The intent of this specification is to ensure that any contaminated soil and/or water encountered during construction will be managed in a manner that complies with applicable regulations, protects worker health and safety, public welfare, and the environment.

Due to the observed presence of contamination as described below, the Contractor shall prepare an Environmental Media Management Plan (EMMP) in advance of construction activities for the identified three areas of contamination noted below. The EMMP shall be prepared and submitted to the Maine Turnpike Authority in accordance with the Submittals section below. The EMMP will outline the procedures to be taken by the Contractor to ensure the appropriate management of impacted soil and groundwater during site disturbance activities. Specifically, the EMMP will outline procedures to be undertaken in areas of potential contamination including:

- Procedure for screening, documenting, sampling, and reporting, if necessary, the presence of impacted soil;
- Practices for minimizing tracking of impacted soil or producing impacted dust;
- Practices and procedures for stockpiling impacted soil including proposed stockpile locations and construction;
- Plan for characterizing stockpiled soil;
- Options for soil disposal or reuse and selecting a disposal facility;
- Procedures for loading and transporting impacted soil; and
- Procedures for handling potentially contaminated groundwater including containerization, sampling, discharge, and/or disposal.

A representative from the Authority's Environmental Services Department shall be notified at least five working days prior to beginning any excavation in areas of identified contamination. The representative shall be on site to observe and document the work. For unanticipated contaminated areas see the Unanticipated Contamination section below.

203.02 Environmental Site Conditions.

Stantec conducted a limited environmental review in 2020 and 2021 consisting of desktop file reviews and site reconnaissance from public areas (documented in Stantec's Limited Environmental Review report dated March 26, 2021) to obtain a general understanding of the environmental conditions along the project corridor. Data garnered from this assessment was used to design a limited subsurface investigation for identified areas of potential concern (documented

in Stantec's Limited Subsurface Investigation Summary dated May 13, 2022). The primary focus of the assessments was to evaluate the type and extent of potential subsurface contamination along the project corridor. The desktop screening included a review of relevant Maine Department of Environmental Protection (MaineDEP), Environmental Protection Agency (EPA) databases, and other applicable local and state databases. The subsurface investigation included drilling of 12 soil borings, screening soil samples with a photoionization detector (PID) for total organic vapors (TOVs) indicative of petroleum contamination, and laboratory analysis of soil and groundwater samples. The results of these investigations are available for review in Stantec's Limited Subsurface Investigation Summary dated May 13, 2022.

Identified Area of Contamination. Stantec's investigation identified three areas where contamination was observed. For reference, these areas are designated as "**Area A**," **"Area B**," and **"Area C**," respectively and shown in the Limited Subsurface Investigation Summary dated May 13, 2022.

The location of **Area A** is defined as located in the vicinity of the former Exit 5 tollhouse roughly between survey stations 626+00 and 627+00 along the current exit ramp to the Ramada Hotel. Within **Area A**, Extractable Petroleum Hydrocarbons (EPH) fractions and target analytes and Volatile Petroleum Hydrocarbons (VPH) fractions and target analytes were detected in soil. EPH fractions and target analytes were also detected in groundwater at this location. Soil and groundwater contamination in **Area A** may be related to the past use and storage of fuel oil at the former tollhouse.

The location of **Area B** is defined as in the vicinity of a current and proposed drain pipe and associated outlet structure adjacent to and on the former Saco Public Works property at 352 North Street, approximately at station 156+50. Within **Area B**, concentrations of EPH fractions were detected in groundwater. No EPH or VPH fractions and target analytes were detected in soil. The source of groundwater contamination in Area B is unknown; however, groundwater investigation in this area was undertaken due to the long-term presence of USTs at the former Saco Public Works facility.

The location of **Area C** is defined as in the vicinity of the Xtramart/Shell gasoline station (337 North Street) at the intersection of North Street and Lund Road, approximately from station 164+00 to the southern project limits along North Street and station 70+00 to the eastern project limits along Lund Road. Roadway and drainage improvements are proposed in this area. Within **Area C**, concentrations of EPH fractions and target analytes were detected in soil, and concentrations of EPH fractions, VPH fractions, and methyl tert butyl ether (MTBE) were detected in groundwater. The source of soil contamination in Area C is likely to be a combination of impacts from the abutting gasoline station and urban fill. The source of groundwater contamination appears to be related to the gasoline station.

Identifying and Screening Contaminated Soil and Groundwater. Within the contaminated sections designated **Area A**, **B**, and **C**, media handling must be completed in accordance with an Environmental Media Management Plan (EMPP). Excavation in these areas will be field screened and classified by the Turnpike Environmental representative in accordance with current Maine regulations and guidance as described within the EMMP.

Although specific soil classifications will be described within the EMMP, it is anticipated that the excavated soils shall be classified as Group 1, Group 2, or Group 3.

Group 1 soils shall have PID field screening measurements indicating relative concentrations of volatile organic compounds (VOCs) less than or equal to 20 parts per million (ppm) as measured in a 200-gram soil headspace using a foil bag.

Group 2 soils shall have PID field screening measurements indicating VOC concentrations greater than 20 ppm as measured in a 200-gram headspace sample and less than the value indicated in Table 1 of SOP-TS004 when screened in accordance with the "Excavation-Construction Worker" clean-up scenario. Field screening will also be done using an oleophilic dye test.

Group 3 soils shall exceed the threshold limit stated in the TS004 Compendium of Field Testing of soil samples exceeding "Excavation-Construction Worker" clean-up scenario or has a saturated result using the oleophilic dye test.

Handling and Disposition of Soil Materials. Although specifics on the disposition and appropriate handling of soil will be described within the EMMP, it is anticipated that soils excavated within **Areas A**, **B**, and **C**, during construction shall be handled as follows:

Group 1 soils are not considered contaminated. Thus, special handling and disposal are not required for Group 1 soils, and they can be used as fill anywhere on site.

Group 2 soils shall be placed back into their excavation section of origin. The Contractor shall make every attempt to side cast any Group 2 soils next to their excavation site. Upon completion of the given constructional feature, the Group 2 soils shall be placed back into the excavation up to two feet below ground surface. Group 2 materials not handled in this manner shall be considered Surplus Group 2 soils. Surplus Group 2 soils must be disposed of or treated at a facility licensed by the MDEP to accept petroleum-contaminated special waste. The Contractor is solely responsible for characterizing waste and obtaining the associated permits and approvals for the disposal or treatment of the Surplus Group 2 soils from all relevant municipal, state, and federal agencies at no additional cost to the Authority. Notification shall be given to the Resident once approval is granted for the acceptance of this material at the off-site facility. No removal of Surplus Group 2 soils from the project shall occur without prior approval by the Resident. If any Surplus Group 2 soils cannot be transported to the pre-approved, properly licensed facility within eight hours of their excavation, they must be placed in a Temporary Secure Stockpile Area somewhere within the project limits (See Temporary Secured Stockpile Area below).

Group 3 soils shall be disposed off site. The Contractor shall arrange and undertake disposal of all Group 3 soils at a landfill or treatment facility licensed to accept petroleum-contaminated special waste. The Contractor is responsible for all additional testing required by the receiving facility. Group 3 soils that cannot be disposed of within eight hours of excavation shall be stored in a Temporary Secured Stockpile area. If the Contractor proposes other disposal or treatment options, the Contractor is solely responsible for obtaining the associated permits and approvals from all relevant municipal, state, and federal agencies at no additional cost to the Authority.

The Authority's designated representative or the Resident is responsible for signing any manifests or bills of lading required to transport and dispose of contaminated soil. All documentation and paperwork associated with the transport and disposal of soils (i.e., manifests/bills of lading, weigh slips, invoices, permits, etc.) shall be forwarded to the Maine

Turnpike Authority's Environmental Services Coordinator at 2360 Congress Street, Portland, Maine 04102 within 30 days of the last shipment of soil to the licensed facility.

Trench and Underdrain/Stormdrain Design in Contaminated Sections. In **Area C**, solid, Option III, non-perforated pipe shall be used instead of perforated underdrain pipe to help prevent the infiltration and transportation of potentially contaminated groundwater within the underdrain/stormdrain system. The Contractor shall backfill around the pipe and trenches in this section with uncontaminated material. Backfilling of the trench shall be in accordance with Section 206.03. All stones larger than three inches, frozen lumps, dry chunks of clay or any other objectionable matter shall be removed before backfilling.

203.04 Secured Stockpile Area.

Should the Contractor temporarily store any Surplus Group 2 or Group 3 soils at the site for more than eight hours following excavation, they must be placed into a properly constructed Temporary Secured Stockpile Area. Although procedures for the proper construction of the stockpile area shall be described within EMPP, the Temporary Secured Stockpile Area must be constructed as defined herein and must be approved by the Resident prior to its use.

Should the Contractor utilize a Temporary Secured Stockpile Area, they shall install a continuous 0.3-meter-high compacted soil berm around the Secured Stockpile. The Secured Stockpile shall be placed on a liner of 20-mil polyethylene and securely covered with 20-mil polyethylene. The polyethylene liner and cover shall be placed over the soil berm and be installed to ensure that precipitation water drains directly to the outside of the berm perimeter while leachate from the contaminated soil is retained within the stockpile. The Secured Stockpile and soil berm shall be enclosed within a perimeter of concrete Jersey barriers or wooden barricades. The area within the Jersey barriers (or wooden barricades) shall be identified as a "restricted area" to prevent unauthorized access to the contaminated soils. As part of the EMMP, the Contractor shall submit to the Resident a plan (sketch and sections) of the proposed secured stockpile areas.

Secured Stockpile Area - Materials.

A. Polyethylene. Polyethylene used for liner in the Secured Stockpile Area shall have a minimum of 20-mil thickness and shall meet the requirements of ASTM D3020.

B. Common Borrow. Fill used in the construction of the Temporary Secured Stockpile Area soil berm shall consist of Common Borrow and meet the requirements of Section 703.18.

C. Concrete Barriers or Wooden Barricades. Concrete barriers or Wooden Barricades to form the sides of the Temporary Secured Stockpile Area shall meet the requirements of Section 526 or 652.

203.05 Health and Safety/Right-to-Know

Contractors and subcontractors are required to notify their workers of the history of the site and contamination that may be present and to be alert for evidence of contaminated soil and groundwater. The Contractor shall notify the Resident **at least five business days** prior to commencing any excavation in **Areas A**, **B**, and **C**.

The Contractor shall prepare a site-specific Health and Safety Plan (HASP) for its workers and subcontractors who may work in the contaminated areas of the site. A Qualified Health and Safety Professional shall complete the HASP. The Qualified Health and Safety Professional will be an expert in field implementation of the following federal regulations:

29 CFR 1910.120 or	Hazardous Waste Operations and
29 CFR 1926.65	Emergency Response
29 CFR 1910.134	Respiratory Protection
29 CFR 1926.650	Subpart D - Excavations
29 CFR 1926.651	General Requirements
29 CFR 1926.652	Requirements for Protective Systems

The Contractor shall designate a person to provide direct on-site supervision of the work in the contaminated area. This person shall have the training and medical surveillance under applicable OSHA regulations including 1910.120 (e) and (f) respectively, as detailed above and in addition be qualified as a construction Competent Person [OSHA 1926.32 (f) and (l)]. It is the responsibility of the competent person to make those inspections necessary to identify situations that could result in hazardous conditions (e.g., possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions), and then to ensure that corrective measures are taken.

Submittals. The Contractor shall submit a site-specific Health and Safety Plan (HASP) to the Resident at least two weeks in advance of any excavation work on the project. The Contractor shall not proceed with work until the Authority has reviewed the plan and notified the Contractor that it is acceptable.

The Contractor shall submit an EMMP to the Resident at least two weeks in advance of any excavation work within suspect contaminated areas. The Contractor shall not proceed with work until the Authority has reviewed the plan and notified the Contractor that it is acceptable.

Health and Safety Monitoring. Within the contaminated areas of the project, the Contractor's designated on-site person shall monitor the worker breathing zone for those constituents specified in the Contractor's HASP. The Contractor shall provide all required health and safety monitoring equipment.

203.06 Media Management

The Contractor shall prepare an Environmental Media Management Plan (EMPP) in advance of construction activities. The EMPP will outline the procedures to be taken by the contractor to ensure the appropriate management of impacted soil and groundwater during site disturbance activities.

203.07 Dewatering

Groundwater may be encountered and its removal necessary to complete work within **Areas A**, **B**, and **C**. It will be treated as "contaminated" water in accordance with the procedures outlined in the EMMP. The Contractor shall inform the Resident before any dewatering commences. The "contaminated" water shall be pumped into a temporary holding tank(s). The Contractor will be responsible for the procurement of any holding tank(s). Any testing, treatment and/or disposal of the stored, petroleum-contaminated water shall be undertaken by the Contractor in accordance with applicable federal, state, and local regulatory requirements.

203.08 On-Site Water Storage Tanks - Materials

If dewatering within the identified contaminated area becomes necessary, the holding tanks used for temporary storage of contaminated water pumped from excavations shall be contamination free and have a minimum capacity of 2,000 gallons.

203.09 Dust Control

The Contractor shall employ dust control measures to minimize the creation of airborne dust during the construction process in potentially contaminated areas. As a minimum, standard dust-control techniques shall be employed where heavy equipment and the public will be traveling. These may include techniques such as watering-down the site or spreading hygroscopic salts.

203.10 Unanticipated Contamination

If the Contractor encounters previously undiscovered contamination or potentially hazardous conditions related to contamination, the Contractor shall immediately suspend work and secure the area. The Contractor will then notify the Resident immediately. These potentially hazardous conditions include, but are not limited to, buried containers, drums, tanks, "oil saturated soils", strong odors, or the presence of petroleum sufficient to cause a sheen on the groundwater. The area of potential hazard shall be secured to minimize health risks to workers and the public and to prevent a release of contaminants into the environment. The source of any suspected contamination shall be evaluated by the Resident (or a representative from the Authority's Environmental Services Department). As appropriate, the Resident will notify the MDEP's Response Services Unit in Augusta and the Authority's Environmental Services Department. The Saco Fire Department(s) must also be notified prior to removal of buried storage tanks and associated piping. The Contractor will evaluate the impact of the hazard on construction, amend the HASP if necessary, and with the Resident's approval, recommence work in accordance with the procedures of this Special Provision.

203.11 Method of Measurement

There will be no measurement for identification and environmental screening of contaminated soil material (this will be done by the Resident or a representative from the Authority's Environmental Services Department).

Measurement for the development of a HASP and providing health and safety equipment and personnel shall be by lump sum.

Measurement for the development of an EMPP shall be by lump sum.

Measurement of the off-site treatment or disposal of Surplus Group 2 and all Group 3 soils will be by the ton of Special Excavation.

There will be no measurement for construction of a Temporary Secured Stockpile Area. Construction of a Temporary Secured Stockpile Area, if necessary, is considered incidental to project construction. There will be no measurement for hauling Surplus Group 2 material or Group 3 soils to the Temporary Secure Stockpile area or placement and removal of Surplus Group 2 or Group 3 soils in or out of the Temporary Secure Stockpile area. All hauling and any subsequent management/placement of contaminated soils are considered incidental to project construction.

There will be no measurement for additional laboratory testing of contaminated soil that is required by the landfill or treatment facility. Testing is incidental to the disposal of Special Excavation.

Measurement for the following items shall be according to Subsection 1093 Extra Work: any necessary contaminated water holding tank(s); and treatment or disposal of any contaminated groundwater.

Basis of Payment. There will be no payment for the identification and environmental screening of contaminated soil material (this will be done by the Resident or Authority representative).

Payment for the development of a Health and Safety Plan (HASP) and providing health and safety equipment and personnel shall be by the lump sum.

Payment for the development of an EMPP shall be by the lump sum.

Payment for off-site disposal or treatment of contaminated Surplus Group 2 and all Group 3 soils at a MDEP-licensed facility shall be by the ton of Special Excavation.

There will be no separate measurement for additional laboratory testing of contaminated soil that is required by the landfill or treatment facility. Testing shall be incidental to Item 203.2333.

There will be no payment for the construction of the Temporary Secured Stockpile Area or hauling/management/placement of contaminated soils to the Temporary Secured Stockpile Area. The Temporary Secured Stockpile Area shall be considered incidental to project construction.

Construction of a Temporary Secured Stockpile Area, or groundwater holding tank, if necessary, will not be measured separately for payment, but shall be incidental to Items 203.2312, 203.2333, and 203.2334.

Pay Item		Pay Unit
203.2312	Health and Safety Plan (HASP)	L.S.
203.2319	Media Management Plan (EMMP)	L.S.
203.2333	Disposal/Treatment of Special Excavation	Ton
203.2334	Disposal/Treatment of Groundwater	Gallon

SPECIAL PROVISION

SECTION 203

EXCAVATION AND EMBANKMENT

(Special Fill – Streambed Material)

203.01 Description

This work shall consist of furnishing and placing stone and granular material within the relocated stream to form a nature-like streambed.

203.02 Materials

Special fill shall be a well graded mix of rounded cobbles, gravel, sand and fines similar in size and shape to those found in natural channels and may be obtained as bank run or screening materials from earth borrow pits. Unwashed stone, and stone with naturally fractured faces will be allowed. No crushed or manufactured angular materials will be allowed.

Where applicable, suitable material excavated on-site within the limits of the stream channel in accordance with Special Provision Section 203, Excavation and Embankment - Dredge Materials, may be used to meet the gradation requirements, or as filler material with the approval of the Resident.

Special fill shall conform to the following requirements:

a. Streambed gravel - shall be well graded bank run gravel. The gradation of the part that passes a 3-inch sieve shall meet the grading requirements of the following table:

Sieve Designation	**Percentage by Weight Passing Square Mesh Sieves**
½ inch	35 - 80
¼ inch	25 - 65
No. 40	5.0 - 30
No. 200	5.0 - 12

Streambed gravel shall not contain particles of rock that will not pass a 6-inch square mesh sieve.

b. 6-inch cobbles - shall be a well graded mix of stones with a minimum size of 3/4 inches and a maximum size of 6 inches average dimension. Fifty percent of the stones by volume shall have an average dimension greater than 3 inches. At least seventy five percent of the material shall be within the specified minimum and maximum sizes.
c. Filler material - shall consist of a well graded mix of gravel, sand and fines used to fill voids and seal the surface of the streambed, and other features (see also Special Provision 610 – Void-Filled Riprap). It shall have enough fines, as determined by visual inspection, so that water pools on the surface. Filler material shall be free from vegetable matter,

debris, peat and other unsuitable material, and shall not contain oversized stones larger than 6 inches. The material may be obtained from earth borrow pits, dredge, on-site excavation or other sources approved by the Resident.

Mix Proportions: Special Fill shall be mixed in the following proportions:

Streambed Gravel	6-inch Cobbles
1 part	1 part

Mix proportions and material gradations shall be within the above limits or as otherwise adjusted by the Resident to obtain a well graded streambed. Acceptance will be based on the test results, and visual inspection by the Resident. Special fill shall conform to the gradation requirements at the time it is placed to form the streambed.

At least 10 working days prior to the start of streambed construction the Contractor shall identify the source and proposed materials for inspection and shall furnish to the Resident a copy of gradation test results from a certified laboratory for the streambed gravel portion of the mix. The Department will obtain samples of the streambed gravel for Process Control prior to placement.

The grading of stone shall be determined by the Resident in accordance with the Standard Specifications, Section 610.032.d Inspection.

203.03 Construction Requirements

1. Construct a channel as defined in the plans with required low-flow channel and in accordance with Special Provision 610 – Void-Filled Riprap. The Contractor shall construct a test section for review by the Resident.

2. Place special fill in well mixed layers without pockets of either fine or coarse material. The material shall be placed by machine or by hand as necessary to achieve the specified shape and thickness. Larger stones may protrude above the average surface but shall be firmly embedded in the mix.

3. Special fill shall be thoroughly washed-in with water immediately after placement. If voids remain in the streambed after the initial washing-in, filler material shall be spread on the surface as required to fill remaining voids. Wash-in with additional water until water remains on the surface with minimal infiltration.

4. Mechanical methods of compaction may be used with the approval of the Resident. If the Contractor uses mechanical methods the void-filling and washing-in requirements shall still apply.

5. Prior to exposure to natural flow conditions the streambed shall be thoroughly wetted and compacted with voids filled and the surface sealed, checked and approved by the Resident. After washing-in, the minimum thickness of the special fill shall be as called for on the plans with an allowable surcharge of up 3 inches above the design grade.

203.04 Method of Measurement

Special fill will be measured in place by the cubic yard.

203.05 Basis of Payment

The accepted quantity of special fill will be paid for at the contract price per cubic yard complete in place. Payment shall be full compensation for furnishing all materials, equipment, and labor and washing-in with water.

Payment will be made under:

Pay Item		Pay Unit
203.33	Special Fill – Streambed Material	Cubic Yard

SPECIAL PROVISION

SECTION 203

EXCAVATION AND EMBANKMENT

(Low Permeability Fill)

203.01 Description

The following sentence is added:

This work shall consist of the placement of Low Permeability Fill as an impermeable soil barrier within the embankment of the Underdrained Soil Filters as shown on the Plans.

203.02 Materials

The following paragraphs are added:

Low Permeability Fill shall conform to the following requirements:

A. Impermeable Soil Barrier

1. Soil to be used as a barrier such as a compacted clay barrier shall consist of glaciomarine silt-clay material with a hydraulic conductivity of less than 10^{-5} (0.0001) cm/sec. Soil barrier material shall be free of organic material, debris, ice, snow, and other deleterious material, with no stone larger than one inch. Unless approved otherwise by the Resident, materials used for the impermeable soil barrier shall contain greater than 90 percent silt and clay content (minus No. 200 U.S. Std. Sieve) by dry weight, a Liquid Limit greater than or equal to 28, and a Plasticity Index greater than or equal to 11.

203.04 General

The following paragraphs are added:

The placement of the Low Permeability Fill shall conform to the following requirements:

1. Moisture Control: The workability of silt clay is acutely sensitive to moisture content. The water content of silt Low Permeability Fill used as fill shall be controlled by the Contractor to stay in the range of two percent dry of the laboratory-determined optimum water content to four percent wet of optimum water content. Silt clay not meeting this range of water contents shall be removed or reworked until the moisture content is within these limits, unless approved otherwise by the Resident.

2. Thickness: The final lift shall be a six inch compacted layer as specified on the Plans.

3. Compaction Criteria: Silt Low Permeability Fill shall be compacted to at least 95 percent of maximum dry density as determined by ASTM D698. The Contractor shall adjust the moisture content of the silt Low Permeability Fill as necessary to achieve the required degree of compaction.

4. Placement: Silt Low Permeability Fill shall be placed in continuous, approximately horizontal layers, not more than 12 inches in loose depth for material compacted by heavy construction equipment, and not more than six inches in loose depth for material compacted by hand-operated tampers. Fill material shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.

   The distribution and gradation of the silt Low Permeability Fill throughout earthwork components shall be such that the fills will be free from lenses, pockets, streaks, or layers of material differing substantially in texture, gradation, or moisture from the surrounding material. The combined excavation, separation, and placement operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable distribution of the material.

5. Compaction: When each layer of material has been conditioned to have the specified moisture, it shall be compacted by at least four passes of the compaction equipment. The passage of compaction equipment in either direction (forward or backward) is considered a single "pass". When compacted, the density shall be essentially uniform throughout the layer. Compacted earth material having a moisture content or dry density that does not meet the criteria specified shall be reworked or re-compacted, as approved by the Resident to obtain the specified moisture content and dry density.

6. Heavy construction equipment shall not operate over the adjacent soil filter bed and underdrain system. Any damage or over compaction of these areas shall be corrected at no additional cost to the Authority.

203.18 Method of Measurement

The following sentence is added after the second paragraph:

Low Permeability Fill will be measured for payment by the cubic yard using the lines, grades and dimensions shown on the Plans.

203.19 Basis of Payment

The following is added after the first paragraph:

The accepted quantity of Low Permeability Fill will be paid for at the Contract unit price per cubic yard. Payment shall be full compensation for obtaining Low Permeability Fill and excavating, loading, hauling, placing, grading and compacting necessary for the formation of the Low Permeability Fill. It shall also include full compensation for disposing of excavated material and surplus material when necessary, and shall include all materials, labor, tools and equipment necessary to complete this work.

Payment will be made under:

Pay Item		Pay Unit
203.52	Low Permeability Fill	Cubic Yard

SPECIAL PROVISION

SECTION 206

STRUCTURAL EXCAVATION

206.02 Construction Methods

The following paragraphs are added:

There are no approved waste storage areas or waste areas within the Project limits. Unsuitable materials shall be disposed of off-site in accordance with Subsection 203.06.

206.05 Basis of Payment

Payment will be made under:

Pay Item		Pay Unit
206.082	Structural Earth Excavation – Major Structures, Plan Quantity	Cubic Yard

SPECIAL PROVISION

SECTION 209

WICK DRAINS

(Prefabricated Vertical Drains)

209.01 Description

This work shall consist of furnishing all necessary plant, labor, equipment, and materials, and performing all operations required to install prefabricated vertical drains (PVDs) in accordance with the details shown on the Plans and with the requirements outlined herein. The PVDs shall consist of a nominally 4-inch wide, band-shaped plastic core enclosed in a suitable jacket material and shall be spaced and arranged as shown on the Plans, or as otherwise directed by the Engineer. The work shall include installing PVDs through a 2 or 3 foot thick drainage layer (i.e., MaineDOT aggregate subbase course – gravel (type D)) and a variable thickness of MaineDOT aggregate subbase course – gravel (type D) placed after grubbing/muck excavation, to a minimum depth of 3 feet below the bottom of the marine clay stratum or to mandrel refusal below the marine clay, whichever is shallower. Pre-auguring, spudding or other methods shall be performed as necessary to penetrate the drainage layer material, frozen ground, in-situ fill soils and debris, dense natural soils or other materials/obstructions present above the marine clay deposit.

PVDs shall be installed to the limits and spacing shown on the Plans. Site grubbing, excavation and removal of all surficial asphalt surfaces, topsoil and debris encountered within the footprint of the embankment area shall be completed prior to PVD installation. The drainage layer shall be placed and compacted to facilitate easy installation of the PVDs. After PVD installation, geotechnical instrumentation shall be installed and initialized prior to the placement and compaction of embankment fill per the requirements of Section 639.

The Contractor shall be responsible for preparing the site to allow safe access and operation of PVD equipment and efficient PVD installation.

The PVDs are intended to accelerate consolidation settlement of the marine clay and facilitate dissipation of excess pore water pressure caused by the placement of the embankment fill. Embankment fill shall not be placed until PVD installation is complete and geotechnical instrumentation has been installed and initialized per the requirements of Section 639.

MATERIALS

209.02a PVD – General

The PVD shall have a minimum 4-inch width and shall be of newly manufactured materials and consist of a polyethylene or polypropylene drainage core enclosed in or integrated with a geotextile jacket. The PVDs shall be band shaped with a width to thickness ratio between 10 and 50. The geotextile jacket shall be made of non-woven fabric of continuous filaments of 100 percent polypropylene or polyethylene. The jacket shall also allow free passage of pore water to the core without loss of soil material or piping (i.e., jacket shall have a range of openings to perform similar to a graded filter). The core shall provide continuous vertical channels or studs on both

sides of a central continuous backing strip. The PVDs shall be capable of resisting all bending, punching, compression and tensile forces imposed during installation and during the design life of the PVD without damage and so that the discharge capacity is not adversely affected. The PVD selected shall retain its permeability and be able to continue to transmit drainage along its entire length even when subjected to as much as 10 to 50 inches of vertical compression that is expected to occur in some areas of the site. The quality of the jacket and core materials shall be resistant for a period of 18 months to wet rot, mildew, bacterial action, insects, salts in solution in groundwater, acids, alkalis, and solvents and any other significant deleterious ingredients in the site groundwater. The jacket and core materials shall be environmentally safe.

Anchors shall be free of rust and sharp or jagged edges. The anchorage arrangement shall fit at the bottom of the mandrel or sleeve and shall permit the installation of the PVD to the required depth, and then shall anchor the PVD tip at that depth during mandrel withdrawal. The dimension of the anchor shall conform as closely as possible to the lateral dimension of the mandrel so as to minimize soil disturbance during PVD installation. The anchor system shall consist of either a bar or plate of the shortest practicable length or area that is necessary to secure the PVDs at the required bottom depth. Trial PVD installations per the requirements outlined herein shall be completed to demonstrate the effectiveness of the anchorage system.

A single type of assembled PVD shall be used on the project unless otherwise agreed to by the Engineer. The actual type of PVD installed will be at the option of the Contractor subject to the requirements specified herein and the review/comment of the Engineer.

209.02b PVD – Jacket

The jacket shall be commercially available, non-woven polypropylene filter fabric.

The jacket material shall not be subject to localized damage (e.g., punching through the filter by sand/gravel particles). The jacket material shall be sufficiently rigid to withstand lateral earth pressures to the maximum project installation depth so that the vertical flow capacity through the core channels will not be adversely affected.

The jacket material shall be sufficiently flexible to bend smoothly during induced consolidation settlement without structural breakage. The function of the drain shall not be affected due to the lateral movements which will likely accompany large settlements. The jacket material shall not undergo cracking and peeling during installation of the drain.

The geotextile jacket material shall conform to the following minimum specifications:

Test Item	Test Designation	Required Average Roll Value (Minimum)
Grab Tensile Strength	ASTM 4632	135 lbs.
Trapezoidal Tear	ASTM 4533	50 lbs.
Puncture Strength	ASTM 4833	38 lbs.
Elongation at Break	ASTM 4632	> 50%
Mullen Burst Strength	ASTM 3786	175 psi
Permittivity	ASTM 4491	0.45 sec-1
AOS	ASTM 4751	≤ US #70 Sieve

* The jacket material shall be tested in saturated and dry conditions. These requirements apply to the lower of the two tested conditions.

The jacket shall also have a minimum permeability of $1x10^{-5}$ cm/sec when tested according to ASTM D4491.

209.02c PVD – Core

The core shall be a continuous polyethylene or polypropylene plastic material fabricated to promote drainage along the long axis of the PVD. The core shall be in physical contact with the jacket but shall not be continuously bonded to the jacket.

The core material shall conform to the following specifications:

Item	Test Designation	Requirement (Minimum)
Tensile Strength	(Uniaxial	235 lbs.
Elongation at Break	extension)	10%

* The core material shall be tested in saturated and dry conditions. These requirements apply to the lower of the two tested conditions.

The mechanical properties (strength and modulus) of the assembled PVDs shall equal or exceed those specified for the component geotextile jacket and core.

Splicing of the jacket and core shall not directly coincide. Necessary splices should be adequately offset to provide structural and hydraulic continuity.

The assembled drain shall have a minimum discharge capacity of 1.3 gal./min. as determined by ASTM D4716.

The assembled drain shall have a minimum equivalent diameter of 2.65 in. using the following definition of equivalent diameter:

$$d_w = \frac{2(a+b)}{\pi}$$

dw = equivalent diameter of a circular drain
a = drain thickness
b = drain width

PVD materials shall be labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label. As a minimum, each roll shall be identified by the manufacturer including lot or control numbers, individual roll number, date of manufacture, and manufacturer and product identification of the component parts (jacket and core).

During shipment and storage, the PVD rolls shall be wrapped in heavy paper, burlap, plastic, or similar heavy-duty protective covering. The PVD rolls shall be protected from sunlight, mud, dirt, dust, debris, and other detrimental substances during shipping, unloading and at on-site storage locations.

All material that is damaged during shipping, unloading, storage, or handling and/or does not meet the minimum requirements as stated herein will be rejected by the Engineer and shall be immediately removed from the site by the Contractor. No payment shall be made for rejected material.

Material shall be stored on site under protective cover to minimize possible damage due to sunlight, general weather conditions, and other site conditions.

209.02d PVD - Drainage Layer

Drainage layer material shall consist of Aggregate Subbase Course – Gravel (Type D) in accordance with the requirements of Standard Specification Section 703 – Aggregates. The drainage layer material shall be placed and compacted to the limits shown on the Plans prior to PVD installation.

209.03 Contractor Requirements

The PVD manufacturer shall be a specialist in the manufacturing of PVDs and shall provide records of having successfully manufactured 1,500,000 linear feet of PVDs on a minimum of five projects within the past five years. Samples of PVD materials shall be submitted to the Engineer for review before delivery of the material to the project.

The PVD Contractor shall have a minimum of 5 years' experience with the installation of PVDs and shall have successfully completed at least five PVD installations within the last five years of similar size (at least 1,500,000 linear feet) and equal to or greater technical complexity in similar subsurface conditions.

The PVD Contractor shall provide at least one superintendent and one operator for the PVD equipment with a minimum of 5 years' experience with the equipment and with PVD installation. The PVD Contractor shall provide detailed information on the training and experience of any operators with less than 5 years' experience for review by the Engineer. In no case shall any superintendent have less than 2 years' experience with the installation of PVDs.

209.04 Submittals

The PVD Contractor shall submit information providing the technical specification of the PVD product. The submittal shall include a description of the equipment and installation schedule and particular descriptions of mandrel dimensions and PVD anchorage methods. The PVD Contractor shall make all submittals not less than 30 calendar days prior to the start of PVD installation. Review of submittals by the Engineer will not relieve the Contractor of the responsibility to provide materials and equipment necessary to install PVDs in accordance with the Plans and specifications/special provisions. If, at any time, the Engineer considers that the method of installation does not produce a satisfactory PVD, the Contractor shall alter its method and/or equipment as necessary to provide PVDs that comply with the requirements of the Plans and specifications/special provisions. The PVD Contractor shall update and resubmit any and all portions of the submittal as changes occur during the course of the work.

The PVD Contractor shall submit proof of five or more projects of similar size and complexity on which they have successfully installed vertical PVDs within the last five years. The following information shall be presented for each project listed as a reference:

1. Project name, location, and start/completion date.
2. Surface and subsurface conditions.
3. The PVD installation equipment and techniques used to install.
4. The minimum, maximum and average rates of PVD installation.
5. Average length of PVD installed and total linear footage of PVD installed.
6. client name and address, and the name and telephone number of the representative of the consultant and owner for whom the work was performed and who can attest to successful completion of the work

The PVD Contractor shall submit written notice of intended installation schedule, by week, at least 30 days prior to the installation of any PVDs.

The PVD Contractor shall submit details of the sequence and method of installation. The submittal shall, at a minimum, provide the following specific information concerning the scheduled work:

1. Plan and narrative describing preparation of the site for PVD installation.
2. Size, type, weight, maximum pushing force, actual pushing force for anticipated installation equipment including rated energy of vibrating hammer (if used), track bearing pressure, and configuration of the installation rig.
3. Shop drawings showing PVD layout and identification numbers for each PVD that will be installed.
4. Dimensions, weight, material composition and length of the mandrel.
5. Details of PVD anchorages that are anticipated.
6. Means of determining the depth of the advancing PVD at any given time and the

length of the PVD installed at each location.
7. Detailed description of proposed installation procedures, including whether water is anticipated to be needed to install PVDs.
8. Estimated minimum, maximum, and average rates of PVD installation.
9. Detailed description of proposed methods for penetrating/removal of the drainage layer material, frozen ground, in-situ fill soils and debris, dense natural soils or other materials/obstructions above the marine clay (e.g., drilling, augering, coring, spudding, near-surface excavation).
10. Proposed plan and narrative for constructing a stable working-surface for installation of PVDs.
11. Manufacturer's literature on PVD material and installation.
12. Means of maintaining verticality/plumbness of mandrel during PVD installation.

The PVD Contractor shall submit PVD manufacturers certification that materials delivered to the site meet the minimum requirements specified herein, prior to delivery of PVDs. The submittal shall include the PVD supplier's certification that delivered material has been properly stored away from sunlight, moisture and dirt. In addition, pertinent tests shall be performed by the manufacturer's selected independent testing laboratory (having certification by an accreditation agency such as American Associate for Laboratory Accreditation relative to the required test methods) on samples representative of PVD material to be used for this project. In addition, one 12-inch length of PVD material shall be collected by the PVD Contractor and submitted to the Engineer for every 50,000 linear feet if installed material. The PVD Contractor shall record the date installed and the PVD roll number and cumulative linear footage from the start of work on the tag for each 12-inch increment.

A minimum of two weeks prior to the start of PVD installation, the PVD Contractor shall submit a sample of the PVD, PVD anchor and one sample of any proposed splices. Each sample shall be at least 5 feet long. Samples of spliced PVD shall be long enough to include the splice plus 2 feet of un-spliced PVD on both sides of the splice.

The PVD Contractor shall submit proposed installation record forms to be used to track production PVD installation. Information on the forms shall include, at a minimum, date and time of installation, rig number, PVD identification number, top elevation, installed length, length of pre-augering or spudding, description of methods used to remove/penetrate materials that hindered PVD installation, including depths materials were encountered, description of any other interruptions, daily quantify summary, total quantity summary, and other contract summary items. Interim reports shall be submitted weekly. A complete copy shall be submitted within two weeks after completion of PVD installation.

209.05 Project Conditions

Prior to bidding, the PVD Contractor shall visit and examine the work site and all conditions thereon and take into consideration all such conditions that may affect this work.

The PVD Contractor shall protect existing structures, underground utilities, overhead utilities, instrumentation, trees, buildings, utility poles, paved areas, and other construction from any possible or potential damage caused by PVD installation.

CONSTRUCTION REQUIREMENTS

209.06 PVD Installation

The Contractor shall provide equipment required for installation of nominal 4-inch wide PVDs. Equipment shall be of a type that will cause a minimum of disturbance to soil subgrades prior to and during PVD installation operation and shall maintain the mandrel in a plumb position. The mandrel or sleeve shall be straight and shall be sufficiently stiff to prevent wobble or deflection during PVD installation.

PVDs shall be installed using a mandrel or sleeve that shall be inserted (pushed) into the soil. The mandrel or sleeve shall protect the PVD material from tears, cuts, and abrasions during installation, and shall be retracted after each PVD is installed. To limit disturbance of the marine clay, the dimensions and cross-sectional area of the mandrel shall be the minimum required to provide stable penetration of the soil deposits. Where needed, use auger/core/drill/spud/etc. of a diameter not greater than 8 inches to pre-drill or spud through the drainage layer material, frozen ground, in-situ fill soils and debris, dense natural soils or other materials/obstructions encountered above or within the marine clay.

The mandrel or sleeve shall be provided with an anchor rod, plate, or similar arrangement at the bottom to permit the installation of the PVD and to anchor the PVD tip at the required depth before withdrawal of the mandrel. The dimensions of the anchor shall conform as closely as possible to the dimensions of the mandrel to minimize disturbance of the marine clay. The Engineer shall determine the acceptability of the anchorage system and installation procedure. The selection of anchoring system is the sole responsibility of the PVD Contractor, but its choice shall be made such as to disturb the least amount of surface area of soil necessary while securing the PVD in the ground. Changes to the anchoring system, if recommended by the Engineer, shall be made by the PVD Contractor at no additional cost to the Authority.

Prior to the installation of the PVDs, the PVD Contractor shall demonstrate that their proposed equipment, methods, and materials produce a satisfactory PVD installation in accordance with the requirements stated herein. The PVD Contractor shall complete a minimum of ten trial PVD installations at specific production location(s) designated by the Engineer. During the trial installations, the PVD Contractor shall demonstrate the intended splicing procedure at least twice by purposely cutting the band PVD and changing out a roll and reattaching the PVD consistent with splicing requirements specified herein. The Engineer may choose trial areas to determine the need for pre-augering prior to production installation. Additional trial PVDs may be required by the Engineer if significant changes in subsurface conditions or installation are noted. The PVD Contractor shall install all trial PVDs in the presence of the Engineer who will observe the installations and determine the PVD Contractor's ability to install the PVDs to the required depths, while maintaining verticality tolerances and with proper splicing procedures. Upon completion of the trial PVD installations, the PVD Contractor and Engineer shall agree upon the proposed equipment, methods, and materials before installing production PVDs.

Review by the Engineer of the method or equipment used to install trial PVDs shall not constitute acceptance of the method for the remainder of the project. If, at any time during production PVD installations, the Engineer believes that the method of installation does not produce satisfactory PVDs, the PVD Contractor shall alter its method and/or modify or change equipment as necessary to comply with requirements as stated herein, at no additional cost to the

Authority.

The PVD Contractor shall clear and grub the site within the footprint of the embankments as shown in the Plans. The PVD Contractor shall provide a drainage layer in the PVD installation area as shown on the Plans and specified herein.

PVDs shall be laid by the Contractor out using surveying methods, numbered, and flagged by the Contractor, relative to a baseline and benchmark established by the Contractor. The Contractor shall take all reasonable precautions to preserve the flags and is responsible for any necessary re-flagging. The as-installed location of the PVDs shall not vary by more than 3 inches from the plan locations designated on the PVD Contractor's shop drawing submittal. The spacing of installed PVDs (in plan) shall be no greater than the dimensions shown on the Plans, as measured at ground surface. If needed, additional PVDs shall be installed in areas where the spacing is greater than the spacing shown on the Plans, to the satisfaction of the Engineer, at no additional cost to the Authority.

PVDs shall be installed from a working surface prepared by the Contractor to the depth required to vertically penetrate the marine clay by at least 3 feet into the underlying granular soil deposit, or to such elevation as directed by the Engineer. The Engineer may vary the depths, spacing, or the number of PVDs to be installed, and may revise the plan limits for this work as necessary.

At each PVD location, a minimum 12-inch length of each PVD shall be left protruding above the ground surface (drainage layer) and cut off neatly at its upper end.

During PVD installation, the PVD Contractor shall provide the Engineer with suitable means of determining the depth of the PVD installed at each location. Footage shall be clearly marked and numbered on the mandrel in an easily visible location that can be read from a safe distance.

PVDs shall be installed using static methods. PVDs that cannot be installed to the design penetration elevations using only static methods shall be advanced using vibratory methods within the following restrictions:

1. A vibratory hammer shall not be used except in cases where design penetration cannot be achieved by using the full static force available to the mandrel, but only with the acceptance of the Engineer.
2. Debris/material encountered above the marine clay deposit shall not be cause for use of a vibratory hammer for the installation of PVDs.

PVDs that are damaged or improperly installed will be rejected by the Engineer and shall be abandoned in place. The PVD Contractor shall install additional PVDs to replace damaged PVDs or those out of specification tolerances as directed by the Engineer, at no additional cost to the Authority.

Where PVDs are to be installed through frozen ground or through hard and dense materials above or within the marine clay soils, the PVD Contractor shall pre-auger, core, drill, or spud through these materials prior to installation of the PVD, as required by the site conditions, but only to the minimum depth needed to penetrate these materials. All predrilled locations shall be

backfilled with either cuttings from the pre-augered hole or sand to the satisfaction of the Engineer.

Equipment for installing PVDs shall be plumbed in both directions prior to installing each PVD and shall not deviate from the vertical by more than 3 inches in 10 feet during installation of any PVD at any time. The PVD Contractor shall provide means for measuring/monitoring plumbness of the mandrel at all times during PVD installation.

Installation techniques requiring driving or jetting of PVDs will not be permitted. The use of water may be allowed if the Contractor is unable to advance PVDs to minimum depths as outlined herein and/or if needed to facilitate anchoring of the PVDs. Water, if needed, shall be introduced into the hole created by the mandrel during PVD installation to counteract hydrostatic uplift forces acting on the PVD anchor at depth. Use of water, if needed to install anchors to the depths required herein shall be conducted by the PVD Contractor at no additional cost to the Authority.

PVD installation shall be performed without any damage to the PVD during advancement or retraction of the mandrel. In no case will alternate raising and lowering of the mandrel during advancement be permitted. Raising of the mandrel will only be permitted after completion of a PVD installation, or upon abandonment from an attempted location.

Where materials are found within the marine clay that cannot be penetrated using normal and accepted procedures (e.g., drilling, augering, coring, spudding), the PVD Contractor shall complete the PVD from the elevation of the materials to the working surface and immediately notify the Engineer.

The PVD Contractor shall implement precautions necessary for protection of any existing utilities, structures, or other existing infrastructure.

The PVD Contractor shall install all production PVDs in the presence of the Engineer. PVDs that are installed to the required penetration into the granular soil deposit below the marine clay, and which are not in violation of any restriction listed in this special provision, will be considered acceptable.

The PVD Contractor shall coordinate the location of the PVDs with the location of the settlement platforms, vibrating wire piezometers and inclinometers shown on the Plans.

The PVD Contractor shall be responsible for penetrating the soils present at the site as necessary to satisfactorily install the PVDs. Satisfactory installation may require removal or penetration of debris/materials that hinder PVD installation. As and if needed, the PVD Contractor may use augering, spudding, coring, or other drilling methods to remove/penetrate debris/materials that hinder PVD installation. The Contractor may use excavation methods to remove near-surface debris/materials encountered. Excavation into the naturally-deposited marine clay soils will not be allowed. Each hole made by pre-augering, coring, other drilling method, spudding shall be backfilled with either the auger/drill cuttings or with sand.

Splicing of PVD material shall be done in a workmanlike manner by stapling to provide structural and hydraulic continuity and a continuous smooth connection of the jacket of the PVD. Other means of splicing may be proposed by the PVD Contractor but may not be used without the review of the Engineer. The jacket and core shall be overlapped a minimum of 6-inches at any

splice. A maximum of one splice per installed PVD will be permitted.

209.07 Method of Measurement

PVDs will be measured by the linear foot installed. The length of PVDs to be paid for shall be the distance the installation mandrel tip penetrates below the working grade. All measurements shall be rounded to the nearest whole foot.

PVDs placed in excess of the length as specified herein will not be paid for unless the additional length was authorized by the Engineer or the Engineer's Authorized Representative prior to or during the PVD installation.

209.08 Basis of Payment

Payment for PVDs shall be made at the contract unit price per linear foot, which price shall be full compensation for the cost of furnishing the full length of PVD material, installing the PVDs, altering of the equipment and methods of installation in order to produce the required end result in accordance with the Plans and specifications/special provisions, and shall also include the cost of furnishing all tools, materials, labor, equipment and all other costs necessary to complete the required work specified herein.

No direct payment shall be made for unacceptable PVDs, or for any delays or expenses incurred through changes necessitated by improper or unacceptable material or equipment.

No direct payment will be made for mobilization, demobilization, obstruction clearance, or constructing any work platform(s). The cost of such shall be included in the unit price bid for PVDs.

Pay Item		Pay Unit
209.29	Prefabricated Vertical Drains	Linear Foot

SPECIAL PROVISION

SECTION 401

HOT MIX ASPHALT PAVEMENT

Section 401 of the Maine Turnpike Authority 2016 Supplemental Specifications is modified as follows:

401.01 Description

The following paragraph is added:

A Quality Control Plan (QCP) is required.

401.02 Materials

Section 401.02 is deleted in its entirety and replaced with the following:

Aggregates for HMA Pavements Coarse Aggregate and fine aggregate for HMA pavements shall be graded such that when combined in the proper proportions, including filler if required, the resultant blend will meet the composition of mixture for the type of pavement specified. Materials shall meet the requirements specified in Section 700 – Materials:

Asphalt Cement	702.01
Aggregates for HMA Pavement	703.07
RAP for HMA Pavement	703.08
HMA Mixture Composition	703.09

Mainline Surface HMA Coarse aggregate: The material retained on the No. 4 sieve, shall consist of angular fragments obtained from crushed quarry stone and be free of dirt or other objectionable materials. Coarse aggregate shall have a Micro-Deval value of 15.0 percent or less as determined by AASHTO T 327. The crushed stone shall have a maximum of 1.5% material finer than the No. 200 mesh when tested in accordance with AASHTO T-11. Flat and elongated particles shall not exceed a maximum of 8% at a 5:1 ratio in accordance with ASTM D-4791. Coarse aggregate angularity shall be a minimum of 95/90 in accordance with AASHTO T-335.

Mainline Surface HMA Fine aggregate: The material passing the No. 4 sieve, shall be crushed manufactured sand free from dirt, clay balls, or other objectionable material. Natural sand may be incorporated into the mix at a rate no greater than 10 percent by weight of total aggregate. The unconfined void content of the fine aggregate blend shall be a 45 minimum value when tested in accordance with AASHTO T-304, method A. AASHTO T-176 sand equivalent value shall be a 45 minimum.

Asphalt Low Modulus Joint Sealer: Asphalt Low Modulus Joint Sealer shall be a modified asphalt and rubber compound designed for sealing and improving the strength and performance of the base asphalt cement and shall conform to ASTM D6690 Type IV and the following specifications:

Cone Penetration	90-150
Flow @ 60°C [140ºF]	3.0mm [1/8 in] max
Bond, non-immersed	Three 12.7mm [½ in] specimens pass 3 cycles @ 200% extension @ -29°C [-20ºF]
Resilience, %	60 min
Asphalt Compatibility, ASTM D5329	pass*

* There shall be no failure in adhesion, formation of any oily exudate at the interface between the sealant and asphaltic concrete or other deleterious effects on the asphaltic concrete or sealant when tested at 60°C [140ºF].

The contractor shall provide the Resident or authorized representative with a copy of the material manufacturer's recommendations pertaining to heating, application, and reheating prior to the beginning of operations or the changing of materials.

Section 401.021 Recycled Asphalt Materials

Delete the second paragraph and replace with the following:

In the event that RAP source or properties change, the Contractor shall notify the Authority of the change and submit new documentation stating the new source or properties. A plant produced test batch meeting all requirements including Hamburg Wheel Tracker results shall be produced using the new RAP source or properties.

Section 401.03 Composition of Mixtures

Section 401.03 is deleted in its entirety and replaced with the following:

HMA pavement mixtures for base, intermediate, shim and local road bridge projects shall be a currently approved MDOT design unless otherwise noted. A maximum of 20% RAP may be used. VMA shall meet the requirements listed in Table 1.

HMA pavement mixtures for Mainline surface paving projects shall conform to the following requirements:

The Contractor shall compose the Hot Mix Asphalt Pavement with aggregate, Performance Graded Asphalt Binder (PGAB), and mineral filler if required. HMA shall be designed and tested according to AASHTO R35 and the volumetric criteria in Table 1. The Contractor shall size, uniformly grade, and combine the aggregate fractions in proportions that provide a mixture meeting the grading requirements of the Job Mix Formula (JMF). The Contractor may use a maximum of 15 percent reclaimed asphalt pavement (RAP) in any mainline surface course.

The Contractor shall submit a job mix formula (JMF) developed for each specified mixture at least 30 days prior to placement.

The JMF shall establish a single percentage of aggregate passing each sieve size within the limits shown in Subsection 703.09. The mixture shall be designed and produced, including all production tolerances, to comply with the allowable control points for the particular type of mixture as outlined in Subsection 703.09. The JMF shall state the original source, gradation, and percentage to be used of each portion of the aggregate and mineral filler if required. It shall also state the proposed PGAB content, the name and location of the refiner, the supplier, the source of PGAB submitted for approval, the type of PGAB modification if applicable, and the location of the terminal if applicable.

In addition, the Contractor shall provide the following information with the proposed JMF:

- Properly completed JMF indicating all mix properties (Gmm, VMA, VFB, etc.).
- Stockpile Gradation Summary.
- Test reports for individual aggregate consensus properties
- Design Aggregate Structure Consensus Property Summary.
- Design Aggregate Structure Trial Blend Gradation Plots (0.45 power chart).
- Trial Blend Test Results for at least three different aggregate blends.
- Selected design aggregate blend.
- Test results for the selected design aggregate blend at a minimum of three binder contents.
- Test results for final selected blend compacted to $N_{max.}$
- Specific Gravity for the PGAB to be used.
- Recommended mixing and compaction temperatures from the PGAB supplier.
- Data Sheets (SDS) For PGAB.
- Asphalt Content vs. Air Voids trial blend curve.
- Test report for Contractor's Verification sample.
- Summary of RAP test results (if used), including count, average and standard deviation of binder content and gradation.

At the time of JMF submittal, the Contractor shall identify and make available the stockpiles of all proposed aggregates at the plant site. There must be a minimum of 150 ton for coarse aggregate stockpiles, 75 ton for fine aggregate stockpiles before the JMF may be submitted. The Authority shall obtain samples for laboratory testing. The Contractor shall also make available to the Authority the PGAB proposed for use in the mix in enough quantity to test the properties of the asphalt and to produce samples for testing of the mixture. Before the start of paving, the Contractor and the Authority's representative shall test a production sample in the Contractor's

laboratory for evaluation. If the Authority finds the mixture acceptable, an approved JMF will be forwarded to the Contractor. The Authority will then notify the Contractor that paving may commence. The first day's production shall be monitored, and the approval may be withdrawn if the mixture exhibits undesirable characteristics such as checking, shoving or displacement. The Contractor shall be allowed to submit aim changes within 24 hours of receipt of the first Acceptance test result for an individual JMF. Adjustments will be allowed of up to 2% on the percent passing the 2.36 mm sieve through the 0.075 mm and 3% on the percent passing the 4.75 mm or larger sieves. Adjustments will be allowed on the %PGAB of up to 0.2 percent. Adjustments will be allowed on GMM of up to 0.010.

Approved mix designs from the previous calendar year may be carried over, however no aim changes will be granted for a carryover mix design and the initial design must not be older than the previous paving season.

The Contractor shall submit a new JMF for approval each time a change in material source or materials properties is proposed. The same approval process shall be followed. The cold feed percentage of any aggregate except natural sand may be adjusted up to 10 percentage points from the amount listed on the JMF, however no aggregate listed on the JMF shall be eliminated. Natural sand may be adjusted up to 5 percent from the amount listed on the JMF but shall not exceed 10% by weight of total aggregates. The cold feed percentage for RAP may be reduced up to five percentage points from the amount listed on the JMF and shall not exceed the percentage of RAP approved in the JMF or for the specific application.

TABLE 1
VOLUMETRIC DESIGN CRITERIA

Design ESAL's (Millions)	Required Density (Percent of G_{mm})			Voids in the Mineral Aggregate (VMA)(Minimum Percent) Nominal Maximum Aggregate Size (mm)				Voids Filled with Binder (VFB) (Minimum %)	Fines/Eff. Binder Ratio
	$N_{initial}$	N_{design}	N_{max}	19	12.5	9.5	4.75		
10 to <30	≤89.0	96.0	≤98.0	13.5	14.5	15.5	15.5	65-80	0.6-1.2

As part of the JMF submittal, there are Hamburg Wheel Tracker requirements, the Contractor shall provide the Authority the test results in accordance with AASHTO T324. The results shall be generated by a third-party independent testing laboratory as approved by the Authority. The test results for each individual specimen as well as the average shall meet the requirements of Table 1A

TABLE 1A
HAMBURG WHEEL TRACKER REQUIREMENTS

Specified PG Binder Grade	Test Temperature (ºC)	Maximum Rut Depth (mm)	Minimum Number of Passes	Minimum Allowable SIP*
64-28	45	12.5	20,000	15,000
64E-28	45	8.0	20,000	15,000
70E-34	45	6.3	20,000	15,000

Section 401.031 Warm Mix Technology

Add the following to the end of the first paragraph:

Weather and seasonal limitations as outlined in section 401.06 may be reduced by a maximum 5ºF with the use of WMA except for HMA being placed over bridge deck membrane.

Section 401.04 Temperature Requirements

Add the following line item after the third bullet:

- Any HMA placed over bridge deck membrane shall have a minimum temperature of 300° F measured directly behind the screed in the uncompacted mat.

Add the following paragraph:

No vehicular loads shall be permitted on newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. The newly paved area may be opened to traffic after the internal temperature of the pavement has cooled to 120° F. The Resident will test the internal temperature of the pavement and shall be the sole judge as to the opening to traffic. The period of time before opening to traffic may be extended at the discretion of the Resident. The lane closure may not be removed until the internal temperature has cooled to 120° F.

Section 401.06 Weather and Seasonal Limitations

The first paragraph shall be deleted and replaced with:

The Contractor may place Hot Mix Asphalt Pavement for use other than a traveled way wearing course, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 45°F or higher and the area to be paved is not frozen. The Contractor may place Hot Mix Asphalt Pavement as traveled way wearing course, provided the air temperature determined as above is 50°F or higher. For the purposes of this Section, the traveled way includes truck lanes, ramps, approach roads, shoulders, and auxiliary lanes. The atmospheric temperature for all courses on bridge decks shall be 50°F or higher.

Section 401.08 Hauling Equipment Trucks for Hauling HMA

Add the following paragraphs:

The undercarriage of haul units actively hauling HMA to the site shall be relatively free of dust / mud agglomerations. Haul units found to be contaminating the paving surface shall be removed from the site and cleaned prior to returning.

The contractor shall supply enough haul units such that paving is continuous and without any delays or paver speed changes during the installation of mainline wearing course or any course placed on a bridge deck. The contractor will be charged a fee of $1000 for every occurrence if paving is either stopped or the paver must slow down to avoid stopping due to inadequate number of haul units at the sole discretion of the Authority. In addition to the fee a Quality Control Violation as outlined in Section 106.4.6 will be issued for every shift which does not have enough haul units. The Quality Control Violation will start at the 2nd incident.

Section 401.09 Pavers

Add the following to the end of the fourth paragraph:

The forward operating speed of the paver shall be limited based on the course being placed. A shim or leveling course shall have a maximum speed of 50 feet per minute (fpm). Any base, intermediate, or surface course shall have a maximum paver speed of 40 fpm. The limited speed is not to be calculated on an average basis over time but shall be the actual limitation at any moment during the paving operation.

Section 401.091 Material Transfer Vehicle (MTV)

The first paragraph shall be deleted and replaced with:

When required by Special Provision Section 403, the paver shall be supplied mixture by a material transfer vehicle (Roadtec SB2500 or approved equal) capable of receiving and storing bituminous mixture from haul trucks, remixing, and delivering the mix to the paver hopper in a consistently uniform manner.

The fourth paragraph shall be deleted and replaced with:

The MTV shall be designed so that the mix receives additional mixing action.

Section 401.11 Preparation of Existing Surface

Add the following paragraph:

The contractor will be permitted to be generally innovative in methods to dry existing wet or damp pavement. Any method which causes damage or burning of the existing pavement, or which causes debris to fly into traffic shall be discontinued.

Section 401.111 Layout

The contractor shall layout the site prior to any pavement course or final striping. Layout shall be achieved by physical measurements obtained every 50’ along the length to be paved or striped from a fixed reference point. The contractor shall transfer the measurements to the pavement surface every 50’ and apply a paint mark at each location. The marks shall then be connected by a smoothed string line and subsequent paint marks applied along the string at no greater than 10’ intervals. The Resident will inspect the layout line before associated activities may begin.

Section 401.165 Longitudinal Joint Density

The first paragraph shall be deleted and replaced with:

When noted in Special Provision Section 403, the Authority will measure the pavement density of longitudinal joints between adjoining mainline travel lanes in both the unconfined and confined condition as determined by the days paving operation.

The eighth paragraph shall be deleted and replaced with:

The minimum density of the completed pavement shall be 92.0 percent of the theoretical maximum density obtained. Two consecutive failing tests shall result in production shut down. Prior to resuming paving operations, the contractor quality control unit shall satisfy the Authority that the paving operation will produce joint densities in compliance with the Specifications.

The eleventh paragraph and associated table shall be deleted and replaced with:

Payment reduction will be applied to each sublot that has a density lower than 92.0% as outlined below.

PERCENT COMPACTION	PERCENT PAY
92.0 or greater	100
91.9 to 90.0	95
89.9 to 88.5	90
88.4 or less	80

Section 401.17 Joints

Delete the following sentence from the third paragraph:

“The Authority may allow feathered or "lap" joints on lower base courses or when matching existing base type pavements.”

The fourth paragraph shall be deleted and replaced with:

When required by Special Provision Section 403, Mainline Longitudinal joints shall be constructed as notched-wedge joint and constructed in a manner that will best ensure joint integrity.

Section 401.18 Quality Control

Add the following paragraph v. to the QCP requirements

v. The contractor shall provide a detailed plan outlining how the number of haul units will be determined and supplied to the project to prevent the paver from stopping on mainline wearing course and bridge deck paving over membrane

The following shall be added to section c. Quality Control Technician(s) QCT:

The QCT shall be on site during paving operations performing quality control activities. QCT's shall not act as equipment operators, trainers or laborers.

Section 401.191 Inspection/Testing

In paragraph nine delete and replace Item #8 with:

8. Secure High-Speed Internet Access

401.21 Method of Measurement

The second paragraph shall be deleted and replaced with:

A reduction in payment will occur when the voids, asphalt content, and density are other than the limits specified below for 100 percent payment. The payment reduction for voids and PGAB content and density will be based upon each sublot (500 tons) of production as specified in Subsections 401.162, 401.163, 401.164, and 401.165. The Contractor may request one retest for each failing sublot for core density only. The original core density and the recut core density shall be averaged together to determine payment for the sublot. No retest will be allowed for voids or asphalt content. The Contractor shall pay $250.00 for each additional core tested. Pavement restoration will not be measured separately for payment but shall be incidental to the respective pay item.

SPECIAL PROVISION

SECTION 401

HOT MIX ASPHALT PAVEMENTS

(HMA Using Hydrated Lime)

The following sections of Section 400 have been revised with following additional requirements.

401.01 Description

The Contractor shall compose Hot Mix Asphalt (HMA) Pavement with aggregate, Performance Graded Asphalt Binder (PGAB), hydrated lime, and mineral filler if required. Hydrated Lime shall be utilized in all mixtures so denoted in Special Provision 403 - Hot Mix Asphalt Pavement.

401.02 Materials

Materials shall meet the requirements specified.

Hydrated Lime	AASHTO 216

401.03 Composition of Mixtures

The Contractor shall compose the Hot Mix Asphalt Pavement with aggregate, Performance Graded Asphalt Binder (PGAB), hydrated lime and mineral filler if required. HMA shall be designed and tested according to AASHTO R35 and the volumetric criteria in Table 1. The Contractor shall size, uniformly grade, and combine the aggregate fractions in proportions that provide a mixture meeting the grading requirements of the Job Mix Formula (JMF).

Hydrated lime shall be used in all HMA at a rate of one percent (1%) by weight of the total dry aggregate including RAP aggregate, if used. The Contractor shall obtain a shipping ticket for each shipment of hydrated lime. The Contractor shall provide the Resident with a copy of each shipping ticket from the supplier, including the date, time and weight of hydrated lime shipped and used in HMA production. The Contractor shall submit a material data sheet for the hydrated lime to the Resident for approval.

The Contractor shall provide the following information with the proposed JMF:
Safety Data Sheets (SDS) for hydrated lime
Supplier and source for Hydrated Lime

401.13 Preparation of Aggregates

The Contractor shall add water to the aggregates as required to maintain a minimum total aggregate moisture content of 3 percent. The Contractor shall mix the lime uniformly with the aggregate before introducing the aggregate into the dryer or dryer drum. Hydrated lime introduction systems must be controlled by a proportioning device to the amount required on the JMF plus or minus 0.1% of the target.

The Contractor shall add lime to the aggregate by one of the following methods:

A. The Contractor shall add lime to the combined cold feed aggregate using an enclosed in-line cold feed mechanical pugmill mixer. The Contractor shall use a twin-shaft, continuous mixing pugmill with mixing paddles to thoroughly blend the lime with the aggregate. The Contractor shall adjust the retention time of the mixture in the pugmill so no unmixed lime is visible after the lime and aggregate exit the pugmill.

B. The Contractor shall add lime to the combined cold feed aggregate by introducing the lime between aggregate layers as the aggregate flows from the cold feed bins. The Contractor shall thoroughly mix the lime and aggregate on the conveyor belt. The Contractor shall provide a lime introduction system so that no unmixed lime is visible before the lime and combined aggregate enter the drum.

The cold storage for hydrated lime shall be a separate bulk storage bin with a vane feeder or other approved feeder system which can be readily calibrated. The system shall provide a means for convenient sampling of the hydrated lime additive and verifying the quantity of lime dispensed. If the hydrated lime is to be introduced directly into the plant then the additive equipment shall be synchronized with the cold feed controls to operate concurrently with the cold feed operation. The system will be configured to automatically adjust the hydrated lime feed to variations in the cold aggregate feed. The hydrated lime system shall have out-of-tolerance sensing ability by weight, and have a means to indicate the out–of–tolerance condition.

401.14 Mixing

Hydrated lime shall be added into the HMA aggregate mixture prior to the aggregate blend mixing with the PGAB. Aggregate feed rate, or pugmill mixing times shall be adjusted to ensure complete blending of Hydrated Lime and aggregate before the PGAB is added.

401.18 Quality Control

The Contractor shall provide a written supplement to the project specific QCP outlining the proposed methods of adding and mixing the hydrated lime for approval by the Authority. This written summary shall also provide information describing how the Contractor will perform quality control on the addition of hydrated lime, specifically the method of introduction and how the lime use will be measured to assure that the specified percentage is consistently added, and appropriately mixed. The supplemental QCP covering hydrated lime introduction shall be provided to the Authority at least one week prior to the prepave meeting.

SPECIAL PROVISION

SECTION 401

HOT MIX ASPHALT PAVEMENT

(Asphalt Rich Base Mixture)

Section 401 of the Maine Turnpike Authority 2016 Supplemental Specification is modified as follows:

401.01 Description

The Contractor shall furnish and place one or more courses of Asphalt Rich Base Hot Mix Asphalt (ARBHMA) on an approved base in accordance with the contract documents and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Resident. The Department will accept this work under Quality Assurance provisions, in accordance with these specifications and the requirements of Section 106 – Quality, the provisions of AASHTO M 323 except where otherwise noted in sections 401 and 703 of these specifications, and the Maine DOT Policies and Procedures for HMA Sampling and Testing.

401.02 Materials

This section has been modified with the following revision:

The Asphalt Rich Base HMA shall be designed for an Air Void Target of 2.5% at 65 Gyrations.

401.03 Composition of Mixtures

This section has been modified with the following revision: The Asphalt Rich Base HMA shall meet the following design criteria.

DESIGN CRITERIA

Gradation	PGAB Minimum
9.5mm mixture	7.0 %
12.Smm mixture	6.5 %
19.0mm mixture	5.8 %

The mixture shall meet the gradation requirements of a current MaineDOT approved 9.5mm, 12.5mm, or 19.0mm 65 Gyration JMF, as required by the contract, and the minimum PGAB content noted above. The Acceptance Limit targets for gradation will be as specified on the JMF.

ACCEPTANCE LIMITS

Property	USL and LSL
Passing 4.75 mm and larger sieves	Target +/-7%
Passing 2.36 mm to 1.18 mm sieves	Target +/-4%
Passing 0.60 mm	Target +/-3%

Passing 0.30 mm to 0.075 mm sieve	Target +/-2%
PGAB Content	Target +/-0.4%
Air Voids	2.5% +/-1.5%
Fines to Effective Binder	0.4 to 1.2
Voids in the Mineral Aggregate	LSL Only from Table 1
Voids Filled with Binder	72 -87.0 *
% TMD (In place density)	96.0% +/- 2.5%

*A production tolerance of 4.0% will apply for the USL.

401.21 Method of Measurement

The following replace the pay tables in section 401.21

CORE DENSITY VS. CORE THEORETICAL MAXIMUM DENSITY COMPACTION 93.5-98.5 PERCENT	
PERCENT COMPACTION	**PERCENT PAYMENT**
93.5 – 98.5	100
92.5-93.4, 98.6 – 99.0	95
92.4-91.5, 99.1 – 99.5	85
<91.5, > 99.5	75
Note: Percent compaction is the percentage of the field core density as compared to the Theoretical Maximum Density (TMD) of that core.	

AIR VOIDS – 1.0 – 4.0 PERCENT	
VOIDS	**PAYMENT PERCENT**
1.0 to 4.0	100
0.5-0.9, 4.1-4.5	90
<0.5, >4.5	75
Note: Voids are based on the average of the test specimens fabricated at the plant for each sublot (500 tons).	

Payment for PGAB content shall be based on the JMF aim with an allowable production tolerance of +/-0.4% except that test results which fall below the minimum PGAB content shall not be permitted:

Gradation	PGAB Minimum
9.5mm mixture	7.0 %
12.Smm mixture	6.5 %
19.0mm mixture	5.8 %

9.5 mm Asphalt Rich Base PGAB CONTENT	
% PGAB	**% PAYMENT**
JMF Aim ± 0.4	100
JMF Aim + 0.5 , - 0.5 , < 7.0	95
JMF Aim + 0.6 , - 0.6 , < 6.9	90
JMF Aim + 0.7 , - 0.7 , < 6.8	85
Note: PGAB content is based on samples tested at the plant for each 500 Ton sublot	

12.5 mm Asphalt Rich Base PGAB CONTENT	
% PGAB	**% PAYMENT**
JMF Aim ± 0.4	100
JMF Aim + 0.5 , - 0.5 , < 6.5	95
JMF Aim + 0.6 , - 0.6 , < 6.4	90
JMF Aim + 0.7 , - 0.7 , < 6.3	85
Note: PGAB content is based on samples tested at the plant for each 500 Ton sublot	

19.0 mm Asphalt Rich Base PGAB CONTENT	
% PGAB	**% PAYMENT**
JMF Aim ± 0.4	100
JMF Aim + 0.5 , - 0.5 , < 5.8	95
JMF Aim + 0.6 , - 0.6 , < 5.7	90
JMF Aim + 0.7 , - 0.7 , < 5.6	85
Note: PGAB content is based on samples tested at the plant for each 500 Ton sublot	

Payment will be made under:

Pay Item		Pay Unit
403.2072	19.0 mm Asphalt Rich Base HMA	Ton

SPECIAL PROVISION

SECTION 403

HOT MIX ASPHALT PAVEMENT

403.01 Description

This work shall also consist of the construction, maintenance and removal of all temporary bituminous ramps at locations as shown on the Plans or as directed by the Resident.

403.02 General

The Contractor shall compose the Hot Mix Asphalt Pavement with aggregate, Performance Graded Asphalt Binder (PGAB), and mineral filler if required. The Performance Graded Asphalt Binder (PGAB) shall be polymer modified as detailed in this special provision and shall conform to the requirements of AASHTO M 332 (including Appendix 1). The PG64E-28 Binder shall contain a minimum of 2.25% Styrene-Butadiene-Styrene (SBS) polymer {BWT} in a homogeneous blend with a minimum average percent recovery of 75% as determined by AASHTO T350 @ 3.2 kPA (R3.2) on RTFO residue at 64ºC to assure significant polymer load and performance. The stability of the modified binder shall be verified in accordance with ATSM D7173 using the Dynamic Shear Rheometer (DSR). The DSR G*/sin(δ) results from the top and bottom sections of the ATSM D7173 test shall not differ by more than 10%. The results of ASTM D7173 shall be included on the Certified Test Report.

When required PG70E-34 Binder shall be modified with Styrene-Butadiene-Styrene (SBS) polymer {BWT} in a homogeneous blend with a minimum average percent recovery of 75% as determined by AASHTO T350 @ 3.2 kPA (R3.2) on RTFO residue at 70ºC to assure significant polymer load and performance. The stability of the modified binder shall be verified in accordance with ATSM D7173 using the Dynamic Shear Rheometer (DSR). The DSR G*/sin(δ) results from the top and bottom sections of the ATSM D7173 test shall not differ by more than 10%. The results of ASTM D7173 shall be included on the Certified Test Report.

403.03 Construction

All areas which have been milled or overlaid shall have a minimum length temporary ramp constructed as determined by the Resident at the milled or overlaid limits prior to opening the roadway to traffic. Temporary ramps shall be constructed using the same material as being placed on that day or as directed by the Resident. All temporary ramps are to be constructed on a sand joint. The Contractor shall be responsible for all repairs and maintenance required for the temporary ramps.

The Contractor shall be responsible for the layout of the longitudinal centerline between the travel lanes.

The sand and loose debris adjacent to the median guardrail shall be removed and disposed of by the Contractor off of Turnpike property.

The forty-five degree pavement safety edge needed between lanes 1 and 2 shall be incidental to the 202 pay items.

A minimum test strip of 100 tons placed at a nominal depth of 1 ½ inches, full lane width, shall be required. It shall be evaluated under testing requirements for mix volumetric and density. The exact location will be identified by the Authority. Prior to placement of the test strip, a leveling course (Item 403.211) shall be placed at the chosen location. A fog coat of Item 409.15, Bituminous Tack Coat, shall be applied to the level course prior to the placement of the HMA surface course, payment to be made under the 409.15 pay item. The test strip will be excluded from the remainder of the projects' QA analysis. The Contractor shall notify the Authority at least 48 hours in advance of placing the test strip. The test strip is intended to allow the Contractor to establish a method of compaction and adjust plant settings prior to mainline plant production.

403.04 Method of Measurement

The construction and removal of temporary ramps on sand joints, and maintaining the ramps will not be measured separately for payment, but shall be incidental to Items 403.

The removal of sand and loose debris will not be measured separately for payment, but shall be incidental to paving items.

Hot Mix Asphalt, 12.5 mm (Polymer Modified pavement with (up to) 15% RAP, placed as a wearing surface will be measured under Item 403.2081 Hot Mix Asphalt, 12.5 mm (Polymer Modified) – RAP.

403.05 Basis of Payment

Hot Mix Asphalt, 12.5 mm (Polymer Modified) pavement with (up to) 15% RAP, placed as a wearing surface will be paid under Item 403.2081 Hot Mix Asphalt, 12.5 mm (Polymer Modified) – RAP.

The following pay items are added:

Pay Item		Pay Unit
403.2081	Hot Mix Asphalt, 12.5 mm (Polymer Modified) – RAP	Ton

SPECIAL PROVISION

SECTION 403

HOT MIX ASPHALT PAVEMENT

Course	HMA Grading	Item Number	Total Thickness	No. of Layers	Complimentary Notes
Mainline Mill and Fill, Reconstruction, and Shim and Overlay					
Wearing	**12.5mm**	**403.2081**	**1.5”**	**1**	**A,D,E,G,H,I,J,K**
Intermediate	**12.5mm**	**403.213**	**1.5”**	**1**	**C, I**
Base	**19.0mm**	**403.207**	**2.5”**	**1**	**C, I**
Base	**19.0mm**	**403.2072**	**4.5”**	**2**	**D, I**
Shim	**9.5mm**	**403.211**	**varies**	**varies**	**C, I**
Collector-Distributor Road and Exit 36 Ramps					
Wearing	**12.5mm**	**403.2081**	**1.5”**	**1**	**A,D,E,G,H,I,J,K**
Intermediate	**12.5mm**	**403.213**	**2”**	**1**	**C, I**
Base	**19.0mm**	**403.2072**	**4.5”**	**2**	**D, I**
Exit 35 Ramps					
Wearing	**12.5mm**	**403.2081**	**1.5”**	**1**	**A,D,E,G,H,I,J,K**
Intermediate	**12.5mm**	**403.213**	**2”**	**1**	**C, I**
Base	**19.0mm**	**403.207**	**2.5”**	**1**	**C, I**
Route 112					
Wearing	**12.5mm**	**403.208**	**1.5”**	**1**	**A,C,E,G,H,I,J,K**
Intermediate	**12.5mm**	**403.213**	**2”**	**1**	**C, I**
Base	**19.0mm**	**403.207**	**2.5”**	**1**	**C, I**
Shim	**9.5mm**	**403.211**	**varies**	**varies**	**C, I**
Spot Shims/Delaminated Areas (As Directed by the Resident)					
Shim	**9.5 mm**	**403.211**	**variable**	**1**	**C, I**
Drives, Sidewalks, and Islands					
Handwork	**9.5mm**	**403.209**	**2”-3”**	**2**	**C**

COMPLEMENTARY NOTES

A. The required PGAB for this mixture shall be **64E-28.**
B. RAP may not be used.
C. The Maine DOT will conduct the job mix verification. The aggregate qualities shall meet the design traffic level of 3 to <10 million ESALS for mix placed under this contract. Minimum and Maximum PGAB content limits from 401.21 shall not apply.
D. The MTA will conduct the job mix verification. The aggregate qualities shall meet the design traffic level of 10 to <30 million ESALS for mix placed under this contract. The design verification, Quality Control, and Acceptance tests for this mix will be performed at **75 gyrations**. (N design)
E. A material transfer vehicle (MTV) shall be used for the placement of Hot Mix Asphalt wearing surface on all roadways including acceleration and deceleration lanes and all ramps.
F. Joints shall be constructed as the "notched wedge" type in accordance with Subsection 401.17.
G. Joint density will be measured in accordance with Subsection 401.165.
H. PGAB shall conform to the provisions of 403.02 – Polymer Modified PGAB for HMA
I. The contractor shall furnish a quality control technician equipped with an approved densometer to ensure density requirements are met.
J. Hydrated Lime shall be incorporated into the mixture.
K. The antistrip additive Zycotherm manufactured by Zydex Industries shall be incorporated into the PGAB at a rate of 0.125%.

SPECIAL PROVISION

SECTION 409

BITUMINOUS TACK COAT

409.01 Description

This Subsection is deleted and replaced with the following:

This work consists of furnishing and applying one uniform application of Emulsified Asphalt RS-1 or RS-1h conforming to the specifications of AASHTO M-140 between all lifts except surface pavement. The application rate shall be 0.04 gal/yd^2

This work consists of furnishing and applying one uniform application of UltraTack (NTSS-1HM) by Blacklidge or an approved equal as indicated in this specification and as per manufacturers' recommendation under surface pavement. The application rate shall be 0.06 gal/yd^2.

The Contractor shall protect all toll slabs from any tracking of tack coat.

409.05 Equipment

Add "or as determined by the Resident", after the words "gal/yd^2]" in the fourth line of the second paragraph of this Subsection.

409.06 Preparation of Surface

The following paragraph is added:

All existing pavement and shoulder areas on which bituminous concrete mixtures are to be placed shall receive a tack coat. The surface area where the tack coat is to be applied shall be dry and cleaned of all dirt, sand, and loose material. Cleaning shall be accomplished by use of revolving brooms or mechanical sweepers. Undesirable material not removed by the above means shall be cleaned by hand sweeping or scraping, or a combination of both. Small areas otherwise inaccessible may be swept with hand brooms. The tack coat shall be applied only when the existing surface is dry.

409.08 Method of Measurement

The following paragraphs are added:

Measurement will be based on delivery slips made out in duplicate by the Contractor and signed by the Resident, or his representative, at the point of delivery. One of these slips shall be retained by the Resident and one by the Contractor. Delivery slips shall be furnished by the Contractor and shall provide space for identifying the vehicle and driver, for stating the volume of material carried, the source of the material, the date, and the Resident or his representative's signature.

Material included in the delivery slips and not used or rejected shall be deducted from the amount being measured for payment. Each day's delivery slips shall be reconciled by the Contractor and the Resident within 24-hours.

Cleaning of the surface area where tack coat is to be applied shall be incidental to Item 409.152, Bituminous Tack Coat - Applied.

409.09 Basis of Payment

The following pay items are added:

Pay Item		Pay Unit
409.15	Bituminous Tack Coat RS-1 or RS1h– Applied	Gallon
409.152	Bituminous Tack Coat NTSS-1HM Trackless– Applied	Gallon

SPECIAL PROVISION

SECTION 419

SAWING AND SEALING JOINTS IN BITUMINOUS PAVEMENT

(Sawing Bituminous Pavement)

419.01 Description

This work consists of sawing bituminous concrete pavement as shown on the Plans, as specified herein or as approved by the Resident.

419.02 General

The bituminous concrete pavement to be sawed shall be accurately marked before cutting. The marking shall be in accordance with the locations as shown on the Plans or as approved by the Resident. Cutting shall be with an approved power driven saw with an abrasive blade.

Unless otherwise noted or directed, the sawcut shall be vertical, a minimum of 3/8 inch wide, and extend to the depth as shown on the Plans.

Residue or debris from the sawing operation shall be removed immediately and legally disposed of by the Contractor.

419.03 Method of Measurement

Sawing Bituminous Pavement will be measured by the linear foot of pavement actually cut and accepted. No additional payment will be made for variations in the pavement thickness.

419.04 Basis of Payment

Sawing Bituminous Pavement will be paid for at the Contract unit price per linear foot which shall be full compensation for all materials, tools, equipment labor, and all incidentals necessary for the completion of the work to the satisfaction of the Resident. The disposal of sawcut residue shall be incidental to this item.

Payment will be made under:

Pay Item		Pay Unit
419.30	Sawing Bituminous Pavement	Linear Foot

SPECIAL PROVISION

SECTION 424

ASPHALT RUBBER MASTIC CRACK SEALER

424.01 Description

This work shall consist of the furnishing and placement of a mastic material in the longitudinal, transverse and random cracks of the milled bituminous concrete pavement in accordance with these Special Provisions.

Placement shall consist of:

1. Crack cleaning and drying
2. Material preparation and application
3. Material finishing and shaping.

424.02 Materials

GAP 201 Mastic shall be supplied by Maxwell Products or an approved equal designed especially for improving the strength and performance of the base asphalt cement with sealant and engineered aggregates.

424.03 Weather

Mastic shall not be applied on a wet surface or when the atmospheric temperature is below 45°F as determined by an approved thermometer (placed in the shade at the crack sealing location), or when weather conditions are otherwise unfavorable for proper construction procedures.

424.04 Equipment

Equipment used in the performance of the work shall be subject to the Resident's or authorized representative's approval and shall be maintained in a satisfactory working condition at all times.

(a) Air Compressor: Air compressors shall be portable and capable of furnishing not less than 4 yd^3 of air per minute at not less than 90 psi pressure at the nozzle. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water.

(b) Sweeper: Manually operated, gas powered air-broom or self-propelled sweeper designed especially for use in cleaning pavements shall he used to remove debris, dirt, and dust from the cracks.

(c) Hot Air Lance: Should operate with propane and compressed air in combination at 2000°F - 3000°F, exit air heated at 310 m/s [1000 ft/s]. The lance should draw propane from no smaller than a 100 pound tank using separate hoses for propane and air draw. The hoses shall be

wrapped together with reflectorized wrap to keep them together and to protect workers in low light situations.

(d) Hand Tools: Shall consist of a square shaped box screed, brooms, shovels, metal bars with chisel shaped ends, and any other tools which may be satisfactorily used to accomplish this work. The joints shall be raked open.

(e) Melting Kettle: The unit used to melt the joint sealing compound shall be a double boiler. indirect fired type. The space between inner and outer shells shall be filled with a suitable heat transfer oil or substitute having a flash point of not less than 320°C [608°F]. The kettle shall be equipped with a satisfactory means of agitating and mixing the mastic. This may be accomplished by continuous stirring with mechanically operated paddles and/or a continuous circulating gear pump attached to the heating unit. The kettle must be equipped with thermostatic control calibrated between 200°F and 550°F.

424.05 Preparations of Cracks

All cracks ¾ of an inch and shall be blown free and raked off of loose material, dirt, vegetation, and other debris by high pressure air. Material removed from the crack shall be removed from the pavement surface by means of a power sweeper or appropriate hand tools as required. Cracks showing evidence of vegetation after being blown out shall be additionally cleaned by appropriate hand tools and additionally blown out. All cracks must be blown and heated via the hot air lance 10 minutes prior to the crack being sealed. Distance between the hot air lance and the crack sealing unit should be no more than 50 ft to eliminate reinvasion of water. debris, and other incompressibles. All debris, vegetation, and water shall be removed to enhance adhesion of the crack sealing material. This work shall not be done in inclement weather.

424.06 Preparation and Placement of mastic

The mastic material shall be heated and applied at the temperature specified by the manufacturer and approved by the Resident or authorized representative. Any material that has been heated above the manufacturer's specification longer than thirty minutes shall not be used. Material that is reheated or held at temperature for an extended period of time may be used as allowed by the manufacturer's specification and approval of the Resident or authorized representative. The Contractor shall provide the Resident or authorized representative with a suitable device for verifying the mastic temperature in the kettle and at the application site.

Any over application or spills are to be removed to the satisfaction of the Resident or authorized representative. Any sealed areas with damaged or contaminated sealer or visible voids are to be removed, prepared and resealed.

Mastic shall be delivered to the crack while the cracks are still hot from the hot air lance preparation through a pressure hose line and applicator shoe. The applicator shall be followed by a V-shaped squeegee to minimize any overband. A heated steel hotplate may be used on the surface of the repair area after the mastic has been applied. Any loose material on the surface or in the crack, which may contaminate the crack sealer or impede bonding of the sealant to the pavement, is to be removed by hand tools prior to crack filling. No crack filling material shall be applied in a crack that is wet or where frost, snow, or ice is present.

424.07 Quality of Work

A Maxwell Products representative shall be present to verify the proper application, installation, material and pavement preparation on the first days' production. Excess of spilled mastic shall be removed from the pavement by approved methods and discarded. Any quality of work determined to be below normal acceptable standards will not be accepted and will be corrected and/or replaced as directed by the Resident or authorized representative at no additional expense to the Authority.

424.08 Method of Measurement

Asphalt Rubber Mastic Crack Sealer - Applied will be measured by the pound of mastic used. The manufacturer's weights of the mastic will be accepted as the basis for measurement.

424.09 Basis of Payment.

Asphalt Rubber Mastic Crack Sealer – Applied will be paid for at the contract unit price per pound complete in place. This price shall be full compensation for furnishing and placing crack sealer, including cleaning and drying cracks; and furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
424.323	Asphalt Rubber Mastic Crack Sealer - Applied	Pound

SPECIAL PROVISION

SECTION 470

BERM DROP OFF CORRECTION

(Berm Dropoff Correction - Grindings)
(Berm Correction)

470.01 Description

This work shall consist of furnishing and placing bituminous grindings to eliminate the berm dropoff along the inside and outside shoulder edges at all locations, including guardrail sections at locations shown on the plans or as directed by the Resident.

The work shall also consist of removing materials at the inside and outside shoulder edges at all locations, including guardrail sections at locations shown on the plans or as directed by the Resident.

470.02 Bituminous Materials

The recycled bituminous pavement shall be reprocessed (crushed) to meet the following gradations:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieve
¾”	100
½”	95-100
No. 4	50-80
No. 50	18-28
No. 200	3-10

470.03 Method of Construction

Work under this item shall be in accordance with the details as shown on the Plans or as directed by the Resident.

At a minimum, a walk behind plate compactor shall be used for compaction. Other methods may be used upon approval by the Resident.

470.04 Method of Measurement

Berm Dropoff Correction – Grindings will be measured by the ton of Pavement grindings delivered and installed.

Material included in the delivery slips and not used or rejected shall be deducted from the amount being measured for payment.

Berm Correction will be measured by the linear foot for material removed.

470.05 Basis of Payment

The accepted quantity of "Berm Dropoff Correction – Grindings" will be paid for at the contract unit price per ton, which price shall include all materials, crushing to gradation range, weighing, transportation, placement, labor, equipment, and all incidentals necessary to accomplish the work.

The accepted quantity of "Berm Correction" will be paid for at the contract unit price per linear foot, which price shall include removing all materials, grading, transportation, labor, equipment, and all incidentals necessary to accomplish the work.

Payment will be made under:

Pay Item		Pay Unit
470.08	Berm Dropoff Correction – Grindings	Ton
470.081	Berm Correction	LF

SPECIAL PROVISION

SECTION 502

STRUCTURAL CONCRETE

(Toll Plaza Entry and Exit Points)

This Subsection of the Supplemental Specifications shall apply in its entirety and shall be amended with the following:

502.01 Description

The following is added to the end of the section:

This work shall also consist of furnishing and placing Portland Cement Concrete for toll plaza pile caps, toll plaza pavement slabs, toll islands, bumpers, barriers, curtain walls, utility pits, mast arm and gantry pedestals and footings, and incidental construction in accordance with the Specifications and in conformity with the lines, grades and dimensions shown on the Plans.

502.175 Miscellaneous Construction of Conduits and Anchor Bolts

All conduit materials and installation procedures shall follow the requirements of Section 626.03 through 626.033 of the MaineDOT Standard Specifications. The Contractor's attention is directed to the need to carefully coordinate the placement of embedded conduits and anchor bolts throughout the structure.

Before placing concrete, the location and position of all embedded conduits, required elbows of entrance conduits, reinforcement, and anchor bolts shall be carefully positioned. The anchor bolt size and the bolt circle diameter shall be determined from data furnished by the supplier of the mast arm or as shown on the Plans. Anchor bolts for use with breakaway couplings, longitudinally grooved-type, shall project between 2-1/2 and 3 inches above the top of the foundation. All anchor bolts shall be a minimum of one inch diameter and shall project sufficiently to accommodate the thickness of the base plus all nuts and washers. The bolt length shall also be sufficient to allow clearances of approximately 1/2 inch below the leveling nut and 1/4 inch above the top nut. At least two threads on each anchor bolt shall project beyond the outside of the nuts holding the plumbed mast arm.

When the anchor bolt template is removed, the threads of the anchor bolts shall be greased and protected with a metal sleeve, held in position with nuts and washers to be furnished with the bolts. This thread protection shall remain in place until the item to connect to the bolts is installed.

A copper-clad steel ground rod shall be installed at the SB toll dual purpose mast arm and at the NB exit gantry.

502.035 Construction Requirements

All horizontal and vertical joints shall be sealed with Sikasil 728 RCS and Sikasil 728 NS, respectively, or an approved equal. Sealing of horizontal and vertical construction joints shall be considered incidental to their respective pay items.

Broadcast sealant shall be applied to the top surface of Entry Toll Plaza slabs and Exit Toll Point slabs after 60 calendar days of concrete cure. Broadcast sealant shall be in accordance with Special Provision 515.

502.18 Method of Measurement

The following is added to the end of the section:

Structural concrete satisfactorily placed and accepted will be measured by the lump sum, in accordance with the dimensions shown on the Plans or authorized changes in the Plans.

The limits to be used in determining the quantities of the aforementioned structural concrete items will be as follows:

1. Structural Concrete, Pavement Slabs The limits will be the entire structural slabs (entry slabs, exit slabs, and approach slabs) bounded transversely and longitudinally by the extreme ends as per plans.
2. Structural Concrete, Plaza Islands, Bumpers and Curtain Walls The limits will be the entire concrete island, outside to outside, both transversely and longitudinally including curbing, as per plans. Concrete bumpers, barriers, and booth enclosure curtain walls placed atop the plaza islands, are included in this item.
3. Structural Concrete, Pile Caps The limits will be the entire pile cap foundation system below the vertical limits of the slabs and bounded transversely and longitudinally by the extreme ends, as per plans. Utility pit slabs and sidewalls located beyond the pile cap limits as well as the pile cap foundation for the dual purpose mast arm are not included in this item.
4. Structural Concrete, Utility Pits The limits will be the entire concrete utility pit, including base slabs, longitudinal sidewalls, and transverse sidewalls below the limits of the pile caps (if present), outside to outside, both transversely and longitudinally, as per plans.
5. Structural Concrete, Pedestals and Footings The limits will be the entire concrete gantry and mast arm pedestals and foundations, from the bottom of the spread footing or pile cap to the top of the pedestal, as per plans.

502.19 Basis of Payment

The following is added to this section:

The accepted work done under structural concrete, of the classes and for the types of work required, will be paid for at the Contract unit price per lump sum for the respective Contract items involved. Payment for miscellaneous construction items such as asphalt for painting or covering

various types of joints, all required sandblasting, bonding, curing, joint sealing, and joint sawing shall be incidental to the respective 502 pay items. No direct payment will be made for concrete admixtures with the exception of Synthetic Fiber Reinforcement, which shall be paid for under its respective Pay Item, 503.90.

Steel reinforcing and GFRP reinforcing will be measured and paid for separately as outlined in Section 503.

Payment will be made under:

Pay Item		Pay Unit
502.262	Structural Concrete, Pavement Slabs	Lump Sum
502.263	Structural Concrete, Plaza Islands, Bumpers and Curtain Walls	Lump Sum
502.264	Structural Concrete, Pile Caps	Lump Sum
502.265	Structural Concrete, Utility Pits	Lump Sum
502.266	Structural Concrete, Pedestals and Footings	Lump Sum

SPECIAL PROVISION

SECTION 502

STRUCTURAL CONCRETE

(Bridge Drain Downspout Extension)
(Weep Drain Extension)

502.01 Description

The following sentences are added:

The work also consists of extending deck weep drains as directed by the Resident and approved by the Engineer.

The work also consists of fabricating, galvanizing, and installing bridge drain downspout extensions as detailed on the Plans.

502.03 Materials

The following sentences are added:

Bridge drain materials shall meet the requirements specified in, and shall be galvanized in accordance with, Division 700, Subsection 711.04, Bridge Drains.

Bridge weep drain extensions shall match the material of the existing weep drains to be extended.

All structural concrete removed shall be replaced with a material from Maine Turnpike Authority's approved concrete patching material list. See MaineDOT Standard Specification Section 518 – Structural Concrete Repair.

502.18 Method of Measurement

The following sentences are added:

G. The Bridge Drain Downspout Extension will be measured per each by the actual number of bridge drain downspout extensions per the Plans, complete in place and accepted.

H. Weep Drain Extensions will be measured by the lump sum, as required on the Plans and directed by the Resident, complete in place and accepted.

502.19 Basis of Payment

The following paragraphs are added:

Bridge Drain Downspout Extension will be paid for at the contract unit price per each, which price shall be full compensation for measuring and preparing the existing bridge drain downspout; fabrication, galvanizing and installation of the Bridge Drain Downspout Extension, galvanizing touch-up, including all materials, labor, tools, equipment and incidentals necessary for furnishing and installing the Bridge Drain Downspout Extension in accordance with the Plans and Specifications.

Weep Drain Extensions will be paid for at the Contract lump sum price, which price shall be the full compensation for measuring and preparing the existing weep drains, providing shop drawings for approval by the Engineer of the intended repair method and materials, fabrication and installation of the weep drain extension, deck removal and concrete repair including all materials, labor, tools, equipment, and incidentals necessary for furnishing and installing the Weep Drain Extensions as detailed in the Plans and Specifications, and as directed by the Resident.

Payment will be made under:

Pay Item		Pay Unit
502.701	Bridge Drain Downspout Extension	Each
502.7011	Weep Drain Extensions	Lump Sum

SPECIAL PROVISION

SECTION 503

REINFORCING STEEL

(GFRP Reinforcing)

503.01 Description

The first paragraph is amended to read:

This work shall consist of fabrication, delivery and placing glass fiber reinforced polymer (GFRP) reinforcement in accordance with these Specifications and in conformance with the Plans, Supplemental Specifications and Special Provisions.

503.02 Materials

The following paragraphs are added:

Materials shall meet the following requirements:

All GFRP reinforcement shall conform to the requirements shown in AASHTO LRFD Bridge Design Guide Specifications for GFRP-Reinforced Concrete, Second Edition (2018), except as shown on the Plans, and as stated herein. All GFRP reinforcement bar shall be sand coated or both deformed and sand coated, except that #12 dowel bars shall be smooth. Deforming methods shall be performed during the fabrication process. GFRP reinforcement shall not be deformed in the field.

GFRP bars shall be from one of the following approved manufacturers or approved equal:

1. Aslan 100 by Hughes Brothers Inc.
2. V-Rod by Pultrall Inc.
3. ComBAR by Schoeck Bauteile.
4. Mateen-Bar by Sigma Development Group, LLC.

All GFRP bars in the same structural component shall be supplied by the same manufacturer.

Documentation

For all GFRP reinforcement bar used on Authority projects, the bar manufacturer shall furnish the Resident with one hardcopy and one electronic copy of written certifications that the GFRP reinforcement meets the requirements of this specification. In addition, the certification shall list the test values and test procedures used to determine the physical properties of the GFRP reinforcement. Certifications bearing the notarized signature of a responsible authorized representative of the bar manufacturer are required. Each bundle of GFRP reinforcement shall be

identified with a corresponding lot number with the lot numbers affixed to each bundle by means of a durable tag.

Repair Material

The material used to repair the cut ends of GFRP reinforcement shall comply with the requirements established by the bar manufacturer.

503.04 Protection of Material

The following paragraphs are added:

Delivery, storage and handling of GFRP reinforcing bars shall be in accordance with these Specifications. Prevent bending, coating with earth, oil, or other material, or otherwise damaging the reinforcement. When handling reinforcement, use equipment to avoid damaging or abrading the bar. Do not drop or drag reinforcement.

GFRP reinforcement shall be stored on skids or other supports a minimum of 12 inches above the ground surface and protected at all times from damage and surface contamination. The storage supports shall be constructed of wood, or other material that will not damage the surface of the reinforcement. Bundles of bars shall be stored on supports in a single layer. Each bundle shall be placed on the supports out of contact with adjacent bundles. Reinforcing bars expected to be stored outdoors for a period in excess of two months, shall be protected from ultraviolet radiation. Prevent exposure of reinforcing to temperatures above 120 degrees Fahrenheit during storage.

All handling of reinforcing bars by mechanical means shall be done by equipment having padded contact areas, or by the use of nylon webbing slings. The use of chains or wire rope slings shall not be allowed, even when used with padding. All bundles of bars shall be lifted with a strong back, spreader bar, multiple supports or a platform bridge to prevent bar-to-bar abrasion from sags in the bundles. Support points during lifting or transporting of bundled reinforcing bars shall be spaced at a maximum of 15 feet, or as required by the manufacturer, whichever is more restrictive.

Bundled bars shall be strapped together with non-metallic or padded straps in a manner to prevent bar-to-bar abrasion due to relative movement between bars.

Bars loaded for transport shall be loaded and strapped down in a manner that will prevent damage from motion and vibration, to the greatest extent possible. Bundles of bent bars shall be transported strapped to wooden platforms or shall be crated. All individual bundles and layers of bundles shall be separated, and supported by dunnage.

Individual bars shall be handled in a manner that prevents damage due to abrasion or impact, and at no time shall any bar be moved by dragging over any surface, including other reinforcing bars. Sufficient personnel shall be assigned to assure compliance with the above.

For GFRP bars the maximum total visible damage permitted on each linear foot shall not exceed two percent of the surface area in that linear foot of bar. The depth of the permissible damage shall not exceed 0.04 inches.

503.06 Placing and Fastening

The following paragraphs are added:

All reinforcement shall be accurately placed in the positions shown on the Plans and shall be firmly held there during the placing and setting of the concrete. Immediately before placing concrete the reinforcement shall be free from all foreign material which could decrease the bond between the reinforcing and concrete. Such foreign material shall include, but not be limited to: dirt, paint, oil, bitumen and dried concrete mortar.

Reinforcing bars within the formwork shall be secured to prevent movement during concrete placement. The bars must be adequately supported or tied to resist settlement, floating upward, or movement in any direction during concrete placement.

Field bending of GFRP shall not be allowed.

Field cutting of GFRP will be permitted only with the approval of the Resident. The field cutting shall be with a high speed cutter, fine blade saw, diamond blade or masonry saw. The GFRP bars shall not be shear cut.

Proper distances from the forms shall be maintained by means of stays, blocks, ties, hangers or other approved means. Blocks used for this purpose shall be precast Portland cement mortar blocks of approved shape and dimensions. Chairs may be used for this purpose and, when used, must be GFRP or plastic. The use of pebbles, pieces of broken stone or brick, metal pipe or wooden blocks shall not be permitted. The placing of reinforcement as concrete placement progresses, without definite and secure means of holding the bar in its correct position, shall not be permitted. Reinforcing bars used as support bars and spreader bars shall be the same type used for the main reinforcing.

Bars shall be fastened together at all intersections except where spacing is less than one foot in either direction, in which case, fastening at alternate intersections of each bar with other bars will be permitted providing this will hold all the bars securely in position. This fastening may be plastic or nylon ties only.

Minimum embedment lengths of reinforcing bars shall comply with the manufacturers published recommendations for the anchoring material selected. These embedment lengths shall be verified by the Resident before installation of the reinforcing bars. The reinforcing bar lengths indicated on the Plans may be reduced, at the Contractor's option, to the determined minimum embedment lengths.

Reinforcement shall be inspected and approved by the Resident before any concrete is placed.

503.07 Splicing

The following sentence is added:

Lap splice length for GFRP bars shall be as per manufacturer's recommendation.

503.10 Method of Measurement

The first sentence of the first paragraph is amended as follows:

GFRP reinforcing bars shall be measured by the computed number of linear feet of reinforcement authorized.

503.11 Basis of Payment

The following is added:

The accepted quantity of GFRP reinforcing will be paid for at the Contract unit price per linear foot for each item involved, completed, and accepted.

Pay Item		Pay Unit
503.18	Glass Fiber Reinforced Polymer (GFRP) Reinforcing Bars, Fabricated and Delivered	Linear Foot
503.19	Glass Fiber Reinforced Polymer (GFRP) Reinforcing Bars, Placing	Linear Foot

SPECIAL PROVISION

SECTION 503

REINFORCING STEEL

(Synthetic Fiber Reinforcement)

The following Subsection shall be added:

503.01 Description

This work shall consist of furnishing synthetic fiber reinforcement to be used as temperature and shrinkage reinforcement in the structural concrete pavement slabs.

503.02 Materials

The following sentence shall be added:

Synthetic fibers shall be STRUX 90/40 as manufactured by W.R. Grace & Co. or an approved equal.

The following Subsection shall be added:

503.021 Dosage

The dosage rate for synthetic fibers shall be three pounds per cubic yard of concrete.

503.10 Method of Measurement

The following sentence shall be added:

Synthetic fiber reinforcement will be measured by the pound.

503.11 Basis of Payment

Payment will be made under:

Pay Item		Pay Unit
503.90	Synthetic Fiber Reinforcement	Pound

SPECIAL PROVISION

SECTION 504

STRUCTURAL STEEL

504.03 Drawings

This Subsection is amended by the addition of the following:

When structural steel erection is to take place over travel ways, the Contractor shall submit a structural steel erection plan stamped by a Professional Engineer licensed in the State of Maine. The erection plan shall include the number and location of crane(s), the weight of the pick, crane capacities, bracing locations and all other pertinent information needed to demonstrate the structural steel can be safely erected and assembled.

504.51 Installation

This Subsection is amended by the addition of the following:

Where an outer face of the bolted parts has a slope of more than one to 20 with respect to a plane normal to the bolt axis, a smooth beveled washer will be used to compensate for the lack of parallelism.

504.641 Method of Measurement

There will be no additional payment for the required erection plan. The cost shall be incidental to the related 504 Toll Canopy, Gantry, and Mast Arm pay items.

SPECIAL PROVISION

SECTION 504

STRUCTURAL STEEL

(Toll Plaza Canopies, Toll Gantry, and Dual Purpose Mast Arm)

504.01 Description

All references to the "D1.5 Code" in this section are deleted and replaced with the "D1.1 Code".

This work shall consist of the furnishing, delivering and installing materials and components to construct new toll plaza canopies over the new NB and SB entry lanes, a new toll gantry over the new NB exiting lane, and a new dual purpose mast arm over the new SB exiting lane, as well as all other related electrical and communication facilities and drainage facilities needed for the new toll plaza that will be attached to these structures as described in the Plan drawings and herein as required for the installation of new canopies, gantry and mast arm at Interchange 35. Shop paint coating of steel and any field touch-up shall be incidental to this work.

504.02 Materials

This section is amended by the addition of the following:

Steel Supports 720.03

Anchor Bolts 720.07

All steel components shall be hot dip galvanized after fabrication.

The materials, procedures, and requirements for the construction of the EPDM roofing system for the toll plaza canopies shall be in conformance with Division 800 Section 075323.

Aluminum roof facias shall have a milled finish.

504.03 Drawings

All references to the "D1.5 Code" in this section are deleted and replaced with the "D1.1 Code".

This subsection is amended by the addition of the following:

Approval for deviations from the contract drawings and/or specifications shall be requested in writing and shall be approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings. Requests for substitution of all specified material shall be submitted in writing, with full documentation (specifications, mill certification, etc.) enabling the Turnpike to evaluate the proposal.

504.18 Base Metal Repairs

All references to the “D1.5 Code” in this section are deleted and replaced with the “D1.1 Code”.

504.26 Welding

All references to the “D1.5 Code” in this section are deleted and replaced with the “D1.1 Code”.

All welding shall be completed in accordance with the D1.1 Code.

504.27 Welding Requirements

All references to the “D1.5 Code” in this section are deleted and replaced with the “D1.1 Code”.

Subsections 504.28 through 504.29 are deleted in their entirety.

The following subsection is added:

504.29 Inspection of Welds

Weld inspection shall be completed in accordance with the D1.1 Code and these requirements.

Unless otherwise specified, all welds shall be inspected in accordance with Subsection 504.64.

The Contractor shall have the fabricator make his own inspection to maintain quality control. Such inspection shall comply with the D1.1 Code and shall be completed by AWS certified welding inspectors in accordance with the appropriate subsections thereof. All welds shall meet the "quality of welds" requirements specified in the sections on "Design of New Bridges" and "Tubular Structures" of the structural welding code.

All welds not meeting these quality requirements shall be repaired and/or replaced by the Contractor to meet these requirements and check tests, without additional cost to the Authority. The procedures, techniques, standards of acceptance, and methods of repair shall be in accordance with the requirements of AWS D1.1.

A. All testing of welds, as herein required, shall be certified by a qualified laboratory engaged by the Contractor and approved by the Resident. The Contractor shall forward the certifications to the Resident and shall pay for all costs of weld inspection and certification as herein specified.

B. The Authority reserves the right to inspect by nondestructive testing techniques all welds and adjacent base metal as he deems warranted. All such additional testing shall be paid for by the Turnpike and at no cost to the Contractor.

504.30 Nondestructive Testing

All references to the "D1.5 Code" in this section are deleted and replaced with the "D1.1 Code".

Magnetic particle testing of welds for members with a thickness of less than 5/16" will be acceptable.

504.32 Tolerances

This subsection is deleted and replaced with the following:

Before erection, the assembled structural steel shall not exhibit a sweep in excess of 0.2 percent of the nominal height or length, as measured with the element in a horizontal position.

Elements that do not conform to the sweep requirements shall be corrected with a method approved by the Engineer.

The following subsection is added:

504.401 General Construction requirements

The erection of steel structures shall be in accordance with the following:

A. The erection of toll plaza canopies, toll gantry, and toll dual purpose mast arms shall be in accordance with the erection procedure as described on the Plans, as approved by the Resident, and as specified herein. Attention is directed to the maintenance and protection of traffic during work adjacent to or over active roadways. The Contractor is advised that any work on the erection of the toll plaza canopies, gantry, or mast arm, or other work that might endanger traffic on active lanes, shall not be commenced until the proper lane closures have been made, or traffic slowdowns have been instituted, in accordance with the requirements of the Contract Documents.

B. Under no circumstances shall the toll plaza canopies, gantry, or mast arm be erected before the expiration of the curing period of all supporting concrete.

The following subsection is added:

504.402 Construction Requirements

The work in this item generally includes, but is not limited to construction of the following:

A. Toll Plaza Canopy: The contractor shall install new canopies over new NB and SB entry lanes as shown in the plan drawings and described within these specifications. The canopy installation shall include shop painted structural steel, EPDM roofing system, canopy and toll booth pit drains from the canopy to the roadway drainage system as shown on the plans, heat trace and all electrical and toll systems mounted to or routed through the canopy, installation of canopy sign supports, coordination with the installation of canopy signs and

luminaires and all other attachments, and all material, labor, equipment, and incidentals required to complete the work.

B. Toll Gantry: The contractor shall install the proposed toll gantry over the NB exit lane as shown in the plan drawings and described within these specifications. The gantry installation shall include all electrical and communication for the toll system, with galvanized or stainless steel mounting hardware, and all material, labor, equipment, and incidentals required to complete the work.

C. Toll Dual Purpose Mast Arm: The contractor shall install the proposed mast arm over the SB exit lane as shown in the plan drawings and described within these specifications. The mast arm installation shall include all electrical and communication for the toll system, with galvanized or stainless steel mounting hardware, and all material, labor, equipment, and incidentals required to complete the work. The work will also include installing one highway lighting luminaire and offset arm, which will be paid separately under Item 634.1751 – Replacement LED Fixture – Supplied by the Authority.

504.65 Method of Measurement

Toll Plaza Canopies, Toll Gantry, and Toll Dual Purpose Mast Arm shall be measured as one lump sum, fabricated, delivered, erected and accepted.

Electrical and communication items associated with the toll system will be paid for under their respective pay items.

504.66 Basis of Payment

Payment shall include all labor, material, equipment, and incidentals required to complete the canopy, gantry, and mast arm installations in accordance with the plans and these specifications.

Shop paint coating of steel and any field touch-up shall be incidental to these items.

All canopy drains and toll booth utility pit drains as shown on the plans, including material, labor and equipment, shall be incidental to these items.

Payment will be made under:

Pay Item		Pay Unit
504.50	Toll Plaza Canopy - Northbound	Lump Sum
504.51	Toll Plaza Canopy - Southbound	Lump Sum
504.61	Toll Gantry - Northbound	Lump Sum
504.62	Toll Dual Purpose Mast Arm - Southbound	Lump Sum

SPECIAL PROVISION

SECTION 506

SHOP APPLIED PROTECTIVE COATING - STEEL

(Toll Plaza Canopies)

506.01 Description

This Specification covers the shop cleaning and painting of the steel framing members and support columns at the new Toll Plaza Canopy Structures, including all connection components (plates, blocks, etc.).

The work shall consist of furnishing all supervisory personnel, competent person(s), labor, tools, equipment, Quality Control activities, materials, and incidentals necessary for satisfactory completion of the work. This work will be considered incidental to Pay Item 504.50 Toll Plaza Canopy - Northbound and Pay Item 504.51 Toll Plaza Canopy - Southbound. Any field touch-up shall also be included.

506.02 Materials

Materials shall comply with the requirements of the respective Subsections of this Specification.

506.03 Submittals

The Contractor shall submit for review by the Authority a materials list and other such details as described within the Plans and the respective Subsections of this Specification.

506.05 Inspection

For the purpose of this Specification, the following definitions shall apply:

Quality Assurance Inspector (Q.A.I.): The Authority’s authorized representative for shop inspection.

Quality Control Inspector (Q.C.I.): The Contractor’s authorized representative for shop surface preparation and application.

Quality Control (Q.C.) is the responsibility of the Contractor. The Q.C.I. shall inspect all aspects of the work and shall supervise required testing. The Q.C.I. shall record measurements and test results in a Job Control Record (JCR). The Q.C.I. shall reject materials and workmanship that do not meet Contract requirements. The results of all testing shall be documented and a copy made available to the Q.A.I. on a daily basis or as requested by the Resident or Q.A.I.

The JCR shall include the following, as applicable:

- Surface Preparation Cleanliness and Anchor Profile – before application of the first or primer coat.
- Environmental Conditions – Ambient temperature, surface temperature, relative humidity, and dew point.
- Dry Film Thickness (DFT) – After the coating has cured and before the application of any subsequent coating.
- Type of testing equipment, model, serial number, and calibration data, if applicable.
- Type of application equipment.
- Coating batch and/or lot number, date of manufacture, and shelf life.
- Manufacturer's certification of conformance.
- Name(s) of applicator(s).
- Cure data, cure times, temperature, and relative humidity.
- Final inspection by the Q.C.I. and acceptance by the Resident or Q.A.I.

Quality Assurance (Q.A.) is the prerogative of the Authority. The Q.A.I. will ensure that the Q.C. is being performed properly, verify documentation, periodically inspect workmanship and witness testing. Q.A. testing deemed necessary by the Resident in addition to the minimum test requirements shall be scheduled to minimize interference with the production schedule.

Quality Assurance Inspector's Authority

The Q.A.I. will have the authority to reject material or workmanship that does not meet the Contract requirements. The acceptance of material or workmanship by the Q.A.I. will not preclude subsequent rejection, if materials or workmanship is found unacceptable, by other authorized representatives of the Authority.

Rejections

Rejected material or workmanship, as described above, shall be corrected or replaced by the Contractor at no additional cost to the Authority.

506.08 Applicator Qualification

Shop applied coating systems shall be applied in facilities holding a current AISC Sophisticated Paint Endorsement (SPE) or has been qualified in accordance with SSPC QP3-Standard Procedure for Evaluating Qualifications of Shop Painting Applicators.

All Contractor and Subcontractor SSPC certifications specified above shall be current and in-place prior to bid opening. The Contractor shall ensure that all required SSPC certifications are kept current throughout the duration of the Contract until final acceptance of the work. A copy of valid current certifications shall be transmitted with the Bid Package.

ZINC RICH COATING SYSTEM

506.11 Materials

This Subsection is deleted and replaced with the following:

The following coating system shall be used. Alternately, an equivalent system may be proposed and used by the Contractor, subject to approval by the Authority:

Manufacturer:	The Sherwin Williams Company
Primer:	Corothane I Galvapac 1K zinc-rich primer
Intermediate:	Corothane I Ironox B moisture-cure urethane
Finish:	Corothane I HS moisture-cure urethane

All three coats of the paint system shall be contrasting colors as follows:

Primer:	Default by the manufacturer
Intermediate:	As approved by the Resident
Finish:	"Toll Booth Dark Blue": Color formula to be provided by the Resident

The Contractor shall provide a dried sample of the specified finish color to the Authority for approval prior to the batching of the finish coat. Sample size, shape, and material shall be agreed upon with the Resident prior to submission.

The Contractor shall provide the paint batch description, lot number, date of manufacture, shelf life, and the manufacturer's published storage requirements to the Resident. The Contractor shall provide the manufacturer's product data sheet for each coating. The product data sheets shall include the manufacturer's recommended requirements for the equipment, surface cleanliness, mixing, thinning, application, environmental conditions, touch-up/repair procedures, and cure times for the entire range of allowable environmental conditions. All product data sheets and MSDS shall be submitted to the Resident for approval prior to initiating any coating work.

The product data sheets shall also provide the minimum and maximum recoat times for the primer and intermediate coat over the expected range of temperatures, relative humidity, and range of acceptable dry film thicknesses. The manufacturer's product data sheets at the time of submission shall be those used during the duration of the Project. Newly published product data sheets may be substituted as approved by the Resident.

506.12 Limits of Work

This Subsection is deleted and replaced with the following:

The approved 3-coat system shall be applied to the new canopy support columns (HSS8x8), roof framing members (HSS12x8 transverse beams, W10x45 stringers, C10x15.3 fascia members, and C5x6.7 diaphragms) and their connections.

The faying surfaces of bolted connections shall be painted with one coat of the zinc-rich primer meeting the AASHTO/RCSC requirements for Class B slip-critical connections. This coat shall not exceed the maximum thickness nor fail to meet the minimum cure time specified on the manufacturer's product data sheet. Both surfaces of bolted connections shall be masked off within two inches of bolt holes after application and curing of the primer for subsequent coating application. Areas required to be field painted after welding and bolting is complete shall meet the application requirements of Subsection 506.16 Coating Repairs and Touch-up.

506.13 Surface Preparation

This Subsection is deleted and replaced with the following:

Prior to abrasive blast cleaning, all corners and edges of members and plates, whether rolled cut or sheared, exposed in the assembled product shall be rounded to approximately an 1/8-inch radius. A series of tangents to the approximate radius will be considered as a rounded. The Contractor shall prepare a plate approximately 2-inch x 12 inch with the appropriate rounded corner and edge. The Q.C.I. and Q.A.I. shall agree upon the acceptability of the corner preparation and the plate shall become the Job Standard. The plate shall remain the property of the Contractor.

Surfaces to be coated shall be abrasive blast cleaned to meet the requirements of SSPC- SP 10/NACE No. 2 or the coating manufacturer's published recommendations, whichever is the more stringent. SSPC-VIS 1 shall be used to determine acceptable cleanliness. The Q.C.I. and Q.A.I. shall evaluate the first piece using VIS 1 as a comparator. No further blast cleaning shall be done until the Q.C.I. and Q.A.I. agree upon the acceptable Job Standard for cleanliness. If more than one method of abrasive blast cleaning is used (e.g., centrifugal blast and compressed air), the acceptable Job Standard shall be established for each method. At the Contractor's option, a sample piece may be abrasive blast cleaned and sealed with a clear coating to preserve the surface preparation and the sample piece may be used as a comparator to establish the agreed upon Job Standard.

After abrasive blast cleaning, the surface shall be visually inspected for fins, tears, delaminations and other discontinuities. Fins, tears, and other discontinuities shall be removed with a grinder or other suitable power tool and the area shall be blended at a slope of approximately 1:20. The affected area(s) shall be abrasive blast cleaned to develop an acceptable anchor profile.

The anchor profile shall meet the requirements of the coating manufacturer's published recommendations. The blast media shall contain enough grit to provide an angular anchor profile. The anchor profile shall be measured in accordance with ASTM D 4417 Method C. If the anchor profile fails to meet the minimum requirements, the Contractor shall re-blast the substrate until the minimum required anchor profile is achieved. If the anchor profile exceeds the maximum allowed in the manufacturer's published recommendations, the substrate shall be coated only with the approval of the Resident.

The Q.C.I. shall measure the anchor profile of the substrate on each plane of the first piece and each additional piece with a significant change in size or geometry. The Q.A.I. will witness

the testing. After it has been established to the satisfaction of the Resident, that the abrasive blast equipment is capable of providing uniform, acceptable surface preparation, a diminished degree of testing may be agreed upon by the Q.C.I. and Q.A.I. The Quality Assurance Inspector may require that the anchor profile be measured and recorded on any surface that is, in the judgment of the Quality Assurance Inspector, unacceptable. Failure to measure anchor profile as required will result in rejection of the surface preparation on the piece in question.

If there is a significant change in surface cleanliness or anchor profile due to blast media degradation or other reasons, the Contractor shall cease the blast operation until corrective action is taken.

If compressed air is used for abrasive blast cleaning, a blotter test shall be performed in accordance with ASTM D 4285 at the beginning of each shift and at any other time the Q.A.I. directs it. The Q.C.I. and Q.A.I. hall be present to witness the blotter test.

The allowable time between abrasive blast cleaning and primer application shall not exceed the manufacturer's published recommendations or eight-hours, whichever is less. If the substrate develops flash rust (rust bloom) before the primer is applied or before the primer application is completed, the piece shall be re-blasted to bare substrate and re-coated.

506.14 Mixing and Application

This Subsection is deleted and replaced with the following:

All protective coating shall be applied using either conventional or airless spray equipment meeting the manufacturer's published recommendations. Striping and touchup of areas less than 36 in^2 may be applied by other methods with the approval of the Resident. Protective coating shall not be applied when the ambient temperature in the immediate vicinity of the piece(s) in question is above 90˚F or below 40˚F. Thinning and mixing of coatings shall be in conformance with the manufacturer's published instructions. Thinner shall be measured using a graduated cup or other container that clearly indicates the amount of thinner being added. Mixing shall be done using the method, equipment and for the amount of time recommended by the coating manufacturer.

Primer, intermediate, and top coat shall be applied in accordance with the manufacturer's published recommendations. Environmental conditions in the immediate vicinity of the surfaces to be coated shall be within the range of the manufacturer's published requirements both during the coating operation and during the curing period. Primer shall not be force-cured.

Environmental conditions shall be measured by the Q.C.I. in the immediate vicinity of the surfaces to be coated. The Q.A.I. may perform environmental testing in addition to the testing performed by the Q.C.I. If there are significant differences between the test results, the differences shall be resolved or explained to the satisfaction of the Resident prior to coating application. The results of the environmental testing shall be recorded in the JCR.

Corners, fasteners, welds, and inaccessible locations shall be striped in accordance with SSPC-PA 1. The Contractor shall meet the minimum Dry Film Thickness (DFT) requirements on all surfaces. The Contractor may stripe with the intermediate coat if approved by the Resident.

Recoat time shall be in accordance with the manufacturer's published requirements for the environmental conditions at the time of application and cure. If the coating is contaminated with dust, debris, over spray or other deleterious material, the surface shall be cleaned in accordance with SSPC-SP 1 immediately prior to recoating. Other methods of cleaning may be used if approved by the Resident.

The Q.A.I. shall be given ample notice in order to inspect the product prior to coating, recoating or removal of paint from the area. "Ample notice" shall be defined at the Pre-Job meeting depending on shop or site conditions.

Substrates that are primed or surfaces that are recoated without notification of the Q.A.I. will be rejected and no further coating shall be done on the piece. Coating applied without notification of the Q.A.I. will be investigated by destructive and non-destructive testing as approved by the Resident and by a review of the JCR. The Resident may reject, conditionally accept, or accept the coating based on documentation and test results. Rejected coating shall be removed and re-applied. Conditionally accepted coatings shall be made acceptable as approved by the Resident. The cost of additional testing and repairs shall be borne by the Contractor.

506.15 Dry Film Thickness

This Subsection is deleted and replaced with the following:

DFT shall be measured in accordance with SSPC-PA 2. The results shall be documented in the JCR. The JCR documentation shall include the actual gage readings, spot average and the location(s).

506.16 Coating Repairs and Touch-up

This Subsection is deleted and replaced with the following:

Touch-up shall be done in accordance with the manufacturer's product data sheet and this Specification. Areas to be touched-up shall be prepared to assure proper adhesion of each coat. Each existing coat shall be feathered back to assure that each touch-up coat is continuous with each corresponding existing coat. The top-coat shall be smooth and uniform in appearance.

Damaged or unacceptable coatings shall be repaired using the same coating system. Environmental conditions cure times, and DFTs shall be in accordance with manufacturer's product data sheet for the coating being applied. Repairs to topcoat shall result in a uniform gloss and color match. The Resident shall have final authority concerning acceptable appearance.

506.17 Handling and Storage

This Subsection is deleted and replaced with the following:

The coating shall be adequately cured before handling, but under no circumstances shall the product be handled before the coating has achieved the manufacturer's published minimum cure time. Coated steel members shall be handled in a manner to avoid damage to the coating. Members shall be lifted and moved using non-metallic slings, padded chains and beam clamps,

softeners, or other non-injurious methods. Material shall be stored, both at the coating facility and in the field, in a manner that prevents damage to the coating.

Material shall not be loaded for shipment until the shop coating has adequately cured and been inspected. The components will be stamped "APPROVED" only after the loading has been completed and approved, and no material shall be shipped without the prior approval of the Resident.

Damage to the coating that is discovered after the product is loaded for shipment to the jobsite shall be documented by the Q.C.I. Repairs shall not be made unless the damaged area is repaired in accordance with Subsection 506.16 Coating Repairs and Touch-up. Repairs that cannot be acceptably done on the truck shall be done in the shop or in the field at the Contractor’s option.

SPECIAL PROVISION

SECTION 506

PAINTING OF STRUCTURAL STEEL

(Field Painting Existing Structural Steel)

All requirements in this specification are the responsibility of the Contractor unless noted otherwise. The provisions of the MaineDOT Standard Specification – Section 506 Shop Applied Protective Coating – Steel do not apply to this Special Provision.

506.01 Description

This section is amended by the addition of the following:

This work shall consist of cleaning and removing areas of existing expansion joint paint to the limits shown on the plans, or as required to complete the work, and as approved by the Resident. The finish coat color shall match the color of the existing expansion joint paint system.

This work shall also consist of applying a zinc-rich protective coating to steel substrate in accordance with the Plans and Specifications.

506.03 Submittals

This section is amended by the addition of the following:

The Contractor shall submit for review by the Authority a materials list and other such details as described within the Plans and the respective subsections of this Specification.

506.05 Inspection

This section is amended by the addition of the following:

The Resident will have the authority to reject material or workmanship that does not meet the Contract requirements.

506.06 Non-Conforming Work

This section is amended by the addition of the following:

Rejected material and workmanship shall be corrected or replaced by the Contractor in accordance with Subsection 106.8.2 of the Standard Specifications.

506.07 Facilities for Inspection

This section shall be deleted in its entirety.

ZINC-RICH COATING SYSTEMS

506.10 Description

This section is amended by the addition of the following:

Work shall consist of application of a two coat, zinc-rich coating system in accordance with this Specification. Where the selected coating system is a three coat system, the intermediate coat shall be omitted and only the primer and top coat shall be applied.

506.11 Materials

This section is amended by the addition of the following:

Coatings systems shall be selected from the Northeast Protective Coating Committee (NEPCOAT) Qualified Products List (QPL) A or B list. The list may be found through the NEPCOAT Web page (http://www.nepcoat.org).

The Contractor shall provide the batch description, lot number, date of manufacture, shelf life and the manufacturer's published storage requirements for each coating to the Resident. In addition, the Contractor shall provide the manufacturer's published instructions for application of each coat of the coating system including equipment, surface preparation, anchor profile, mixing, thinning, application, cure time for the entire range of allowable environmental conditions, dry film thickness (DFT) and recoat time.

506.13 Surface Preparation

This section is amended by the addition of the following:

Prior to cleaning, all corners and edges of members and plates, whether rolled cut or sheared, exposed in the assembled product shall be rounded to approximately 1/8 inch radius. A series of tangents to the approximate radius will be considered as rounded

Surfaces to be field-painted shall be power tool cleaned to meet the requirements of SSPC-SP3. All surfaces shall be solvent wiped in accordance with SSPC-SP1 following power tool cleaning. Faying surfaces shall be blast cleaned to bare metal to meet the requirements of SSPC-SP6.

After cleaning is complete, the surface shall be visually inspected for fins, tears, delaminations and other discontinuities. Fins, tears and other discontinuities shall be removed with a grinder or other suitable power tool and the area shall be blended at a slope of approximately 1:20.

The allowable time between cleaning and primer application shall not exceed the manufacturer's published recommendations or eight hours, whichever is less. If the substrate develops flash rust (rust bloom) before the primer is applied or before the primer application is completed, the piece shall be re-blasted to bare substrate and re-coated.

506.14 Mixing and Application

This section is amended by the addition of the following:

All protective coatings shall be applied using a method approved by the Resident. Protective coating shall not be applied when the steel temperature, or the ambient temperature in the immediate vicinity of the piece(s) in question; See manufacturers guidelines for temperature limitations. Thinning and mixing of coatings shall be in conformance with the manufacturer's published instructions. Thinner shall be measured using a graduated cup or other container that clearly indicates the amount of thinner being added. Mixing shall be done using the method, equipment and for the amount of time recommended by the coating manufacturer.

Primer and topcoat shall be applied in accordance with the manufacturer's published recommendations. Environmental conditions in the immediate vicinity of the surfaces to be coated shall be within the range of the manufacturer's published requirements both during the coating operation and during the curing period. Primer shall not be force cured.

Recoat time shall be in accordance with the manufacturer's published requirements for the environmental conditions at the time of application and cure. If the coating is contaminated with dust, debris, over spray or other deleterious material, the surface shall be cleaned in accordance with SSPC-SP 1 immediately prior to recoating. Other methods of cleaning may be used if approved by the Resident.

The Resident shall be given ample notice in order to inspect the product prior to coating, recoating or removal of paint from the area. "Ample notice" shall be defined at the Pre-Job meeting depending on shop or site conditions.

Substrates that are primed or surfaces that are recoated without notification of the Resident will be rejected and no further coating shall be done on the piece. Rejected coating shall be removed and re-applied. The cost of repairs shall be borne by the Contractor

506.16 Touch-up and Repairs

The first paragraph is deleted and replaced with the following:

Damaged or unacceptable coatings shall be repaired. Damaged areas shall be prepared in accordance with the manufacturer's published instructions or as directed by the Resident. Damaged or unacceptable coatings shall be repaired using the same coating removed and prepared for repair. Environmental conditions, cure times and DFTs shall be in accordance with manufacturer's published directions for the coating being applied. Repairs to topcoat shall result in a uniform gloss and color match. The Resident shall have final authority concerning acceptable appearance.

506.17 Handling and Storage

The coating shall be adequately cured before handling but under no circumstances shall the product be handled before the coating has achieved the manufacturer's published minimum cure time. Coated steel members shall be handled in a manner to avoid damage to the coating. Members shall be lifted and moved using non-metallic slings, padded chains and beam clamps, softeners or

other non-injurious methods. Material shall be stored, both at the coating facility and in the field, in a manner that prevents damage to the coating.

506.29 Field Coating System

H. Coating Application:

Complete protection from coating spatter, spillage, overspray, wind-blown coating, or similar releases of coating shall be provided. Covers, tarps, mesh, and similar materials shall be placed around the work area to protect public and private property, pedestrian, vehicular, marine or other traffic, all portions of the bridge, highway appurtenances, waterways, and similar surrounding areas on property, upon, beneath, or adjacent to the structure.

Spray coating will be permitted only within a containment that will contain all of the sprayed material, as approved by the Engineer.

506.60 Method of Measurement

Field Painting Existing Structural Steel shall be measured by the lump sum, complete and accepted. The limits shall be as shown or described in the Contract Documents.

506.61 Basis of Payment

All work for Field Painting Existing Structural Steel will be paid for at the lump sum price. Payment will be full compensation for all labor, materials and equipment required to complete the surface preparation and field painting work, including, but not limited to, coating and cleaning materials, staging or accessing, testing, surface preparation, cleaning, application, and repairs.

Payment will be made under:

Pay Item		Pay Unit
506.142	Field Painting Existing Structural Steel	Lump Sum

SPECIAL PROVISION

SECTION 508

WATERPROOFING MEMBRANE

(High Performance Waterproofing Membrane)

508.01 Description

The following paragraph is added to the end of the section:

The membrane installation shall include reinforced corners at the intersection of the bridge deck and bridge curb. The reinforced corners shall be constructed as illustrated in Appendix D and in strict accordance with the manufacturer's published recommendations.

508.02 Materials

Replace the section with the following:

High Performance Membrane shall be Psoralene Flam Antirock Membrane manufactured by Soprema USA.

The high performance membrane installation shall include all materials, as recommended by the manufacturer, to produce a waterproof barrier on the specified concrete surface. In addition to the membrane, these materials may include primer, ALSAN Flashing, aggregate scatter, tack coat, and ALSAN Polyfleece reinforcement.

The Contractor shall provide corner details reinforced as shown in Appendix D using ALSAN Polyfleece polyester reinforcement as supplied by Soprema USA, 310 Quadral Dr, Wadsworth, OH 44281.

508.04 Construction – General

Add the following paragraph after the second paragraph:

Prior to the installation of the Soprema High Performance Membrane, any notch in the vertical surface of the curb shall be filled with an approved grout. The finished surface shall be a vertical plane along the curb.

508.05 Installation – Sheet Membrane

Delete this subsection in its entirety.

508.06 Installation – Torch Applied High Performance Membrane

Remove the third paragraph of this subsection and replace with the following:

After installation of the waterproofing membrane, ALSAN Flashing shall be applied to the vertical curb face up to within ½ inch of the top of the HMA wearing surface or to ½ inch above the filled notch in existing granite curb, whichever is greater. The Flashing shall also be applied to the membrane surface and extend a minimum of 1" beyond the limits of ALSAN Polyfleece polyester fabric. Polyester fabric shall be applied to the vertical Flashing surface, beginning 1" below the top of HMA wearing surface or beginning at the filled notch in existing granite curb, to the interface of the deck and vertical face, and extend a minimum of 8" horizontally along the surface of the waterproofing membrane. Following installation of the polyester fabric into the wet ALSAN Flashing, an additional layer of ALSAN Flashing shall be applied immediately with limits not less than the previous ALSAN Flashing layer. After these applications have dried, a third layer of ALSAN Flashing shall be applied. The final layer of ALSAN Flashing can be left exposed or ceramic granules may be broadcast into the Flashing prior to it drying. Application rates shall be 2 gallons per 100 square feet for all layers. Curing for all layers shall conform to the manufacturer's recommendations.

508.07 Installation – Spray Applied High Performance Membrane

Delete this subsection in its entirety.

508.09 Basis of Payment

Add the following sentence:

The lump sum price shall also include furnishing and installing the specified reinforced membrane corners as described herein, and in accordance with the manufacturer's specifications, including all equipment, materials, incidentals, and labor necessary to satisfactorily complete the work.

SPECIAL PROVISION

SECTION 511

COFFERDAMS

(Cofferdam – Goosefare Brook)

511.01 Description

This work also includes bypass pumping as required by the Plans and Specifications to maintain downstream flow at Goosefare Brook Culvert at all times on the northbound and southbound ends. Management of excavation "dirty water" and of pumped bypass water shall be discharged to a dirtbag or similar BMP in an upland location and is included in this work.

511.03 Cofferdam Construction

The first paragraph is deleted and replaced with the following:

A. Working Drawings. The Contractor shall submit Working Drawings, showing the materials to be used and the proposed method of construction of cofferdams to the Authority. All cofferdam design computations, plans, and working drawings shall be designed and sealed by a Professional Engineer licensed in accordance with the laws of the State of Maine. Construction shall not start on cofferdams until such Working Drawings have been submitted, reviewed and accepted by the Resident. Any review of or comment on, or any lack of review of or comment on, these Working Drawings by the Authority shall not result in any liability upon the Authority and it shall not relieve the Contractor of the responsibility for the satisfactory functioning of the cofferdam.

   Cofferdams and temporary earth retaining structures shall be designed to support all appropriate combinations of earth, static water, stream pressure, ice loads and surcharge loads (from traffic, construction equipment, material stockpiles, and other sources) imposed on the system during all phases of construction. The Contractor's design shall consider the means and methods and construction sequencing proposed by the Contractor. The height of the cofferdam and all related details shall be determined by the Contractor's Engineer. The working drawings shall indicate the water elevation above which the cofferdam should be flooded to avoid overloading.

   Design computation, where required, shall be in accordance with the requirement of either the AASHTO Standard Specifications for Highway Bridges, 17th edition, or the AASHTO LRFD Bridge Design Specifications, Latest Edition. Additionally, the Contractor's Engineer shall design the cofferdam to conform to all Federal, State, County and Local Regulations and Permits.

511.06 Basis of Payment

The accepted quantity of cofferdam will be paid for at the Contract lump sum price for the respective cofferdam items, which price shall be full compensation for design, construction,

maintenance, inspection, and removal of both the northbound and southbound side cofferdams at Goosefare Brook and management and discharge of excavation “dirty water” and bypassed water.

Payment will be made under:

Pay Item		Pay Unit
511.071	Cofferdam – Goosefare Brook	Lump Sum

SPECIAL PROVISION

SECTION 513

SLOPE PROTECTION

(Slope Protection – Portland Cement Concrete)

513.01 Description

The following sentence is added:

This work shall also include the replacement of existing concrete slope protection removed as required for roadway widening as shown in the Contract Plans. This work shall also include grading and gravel borrow required to install the new slope pavement.

513.02 Materials

The following sentences are added:

Welded steel wire fabric and other embedded steel components shall be epoxy coated meeting the requirements of ASTM A884.

513.03 Portland Cement Concrete

Prior to placing new concrete slope protection, the surfaces of the existing slope pavement be in contact with the new slope protection shall be cleaned to remove dirt, loose particles, and foreign matter.

Joints in the concrete slope pavement at the North Street underpass bridge shall be sealed after placement with a polyurethane sealant such as Sikaflex 1a or approved equal.

513.07 Basis of Payment

The following sentence is added:

Payment for Portland Cement concrete slope protection shall also be full compensation for excavating, shaping and compacting, granular borrow, and steel mesh reinforcement required for placement of the slope protection in accordance with the Plans. Payment shall also include cleaning of existing surfaces and sealing joints as noted in the Contract Plans.

SPECIAL PROVISION

SECTION 515

PROTECTIVE COATING FOR CONCRETE SURFACES

(Pigmented Concrete Protective Coating)

Section 515, Protective Coating for Concrete Surfaces, is deleted in its entirety and replaced with the following:

515.01 Description

The work shall include the surface preparation and application of a pigmented concrete protective coating system, consisting of a pigmented penetrating sealer, to protect new and existing concrete and masonry structures. The coating system shall be applied to the exposed portions of the proposed cast-in-place facing of the permanent soil nail retaining wall and the exposed portions of the Route 112 (North Street Underpass) existing abutments and wingwalls in accordance with the Plans, Specifications and the manufacturer's published recommendations.

Where clear or pigmented protective coatings are already present on concrete surfaces specified to receive new protective coatings, the work shall also include removing areas of existing protective coating that are blistered, flaking, peeling, or otherwise loosely adhered to the concrete substrate prior to application of the new coating.

515.02 Materials

The pigmented penetrating sealer system shall be a one-coat system consisting of ChemMasters TextureDOT Smooth, as manufactured by ChemMasters, Inc., or an approved equal, consisting of the following:

- The coating shall be an acrylic silane polymer blend or an approved equal. This primer shall provide the main protection against the ingress of water borne chlorides and sulfates.

The products shall comply with regulations limiting the Volatile Organic Compound (VOC) content of architectural and industrial maintenance coatings.

The Contractor shall submit the product data sheets, material safety data sheets and recommended instructions for application of the ChemMasters Texture DOT Smooth coating.

The pigmented penetrating sealer color shall be Concrete Gray, Federal Number 16492.

Materials shall be delivered to the site in original packages or containers bearing the manufacturer's labels and identification.

515.021 Substitute Materials

The Contractor shall submit a written request for approval of proposed substitute material naming the proposed manufacturer and product. This request shall be accompanied by:

1. Test data from an independent testing laboratory stating that the proposed substitute meets or exceeds the specified requirements as listed and has been tested in accordance with the specified test standards.

2. Documentation that the proposed material has a proven record of performance when used in the intended application as confirmed by actual field tests and successful installations in place on at least five similar projects.

3. Certification that if two or more types of products are intended to be used as part of a system, they will be supplied by the same manufacturer to ensure compatibility of materials, and to maintain single source manufacturer responsibility.

The Resident reserves the right to require additional testing to evaluate any proposed substitute product at no additional cost to the Authority. The Resident's decision as to the acceptability or non-acceptability of the proposed product shall be final.

515.03 Surface Preparation

The surface shall be prepared in accordance with the instructions of the approved manufacturer. Surface shall be fully cured, dry, and free from contamination such as coatings, oil, grease, loose particles, decaying matter, moss, algae growth, and curing compounds. The Contractor shall lightly sandblast the surface to achieve an adequate surface roughness for coating adhesion, in accordance with manufacturer’s recommendations. After sandblasting, all surfaces shall be rinsed by pressure washing, and allowed to air dry for a minimum of 48 hours. Once the surface preparation has been completed to the satisfaction of the Resident, the Contractor may apply the protective coating.

All caulking, patching, and joint sealant shall be installed and cured prior to application of the protective coating.

Existing form tie hole plugs which are loose or deteriorated shall be completely removed. The holes shall be reamed to sound concrete. All open form tie holes, new and existing shall be filled with an approved non-shrinking mortar, and after setting, rubbed level to the adjacent surface. Filled holes shall be cured for at least two (2) days prior to the application of the protective coating.

Grass and vegetation adjacent to surfaces to be coated shall be removed or trimmed closely to permit proper preparation and application of the protective coating.

Where protective coatings are specified to be applied to concrete surfaces that have been previously covered with pigmented coating, the Contractor shall remove any protective coating that, in the judgement of the Resident, is blistered, flaking, peeling, or otherwise loosely adhered to the concrete substrate. Loosely adhered coating shall be generally defined as any coating that can be removed by vigorously scraping the concrete surface using a 3” steel putty knife and firm

pressure. The goal of the removal work is to remove areas of flaking, missing or otherwise compromised coating systems; protective coatings that are tightly adhered to the concrete substrate need not be removed.

The removal of existing protective coatings shall be completed using high pressure washing. The specific pressure, flow rate, nozzle and standoff distance for the high-pressure washing operation shall be selected by the Contractor to remove loosely adhered coatings as specified. After high-pressure washing, the Resident shall verify all loosely adhered coatings have been removed from the specified areas by scraping the surfaces with a putty knife. The Contractor will be required to complete additional pressure washing to remove any remaining loosely adhered coatings identified by the Resident.

The Contractor may use, when required, appropriate cleaning materials recommended by the sealer manufacturer in conjunction with high pressure washing with a rotating nozzle head. Following removal of existing coating systems, all surfaces of the substructure unit to be coated shall be lightly sandblasted to achieve a surface roughness adequate for coating adhesion, then cleaned and rinsed by pressure washing.

The Contractor will be responsible for controlling and filtering runoff resulting from the pressure washing operations in accordance with Supplemental Specification 656, and all local, state and federal requirements.

515.04 Application

The materials shall be mixed and applied in strict accordance with the instructions of the approved manufacturer. Apply the coating at the recommended application rate. If the surface is very absorbent, the coating should be applied until surface is saturated per the manufacturer's written instructions. All areas not to receive coating shall be marked with straight, even lines as the limit lines.

The Contractor shall, in the presence of the Resident, apply the materials on a sample area which is representative of a jobsite application. When color and application methods are approved, the sample area shall serve as a standard of acceptance for all further work.

The application shall not be conducted when surface and air temperatures are below 40°F or above 90°F. The work shall not be conducted when there is a chance of the surface temperature falling below 40°F in the 24-hours following application; nor should it be applied on hot, windy days.

The treatment shall not be applied during rain to wet surfaces or when there is a chance of rain within 48-hours after application. It shall not be applied when winds are sufficient to carry airborne chemicals to unprotected surfaces.

The coating shall not be applied in direct sunlight when the air or surface temperature is greater than 90°F, or when air or surface temperature is below 45°F.

Coating material shall be applied per the manufacturer's recommended application rate and in strict accordance with the manufacturer's written instructions. The coating shall provide

consistent color without light spots or shadows. The Resident reserves the right to have the Contractor recoat coating if the dried coat lacks consistent color or shows light spots or shadows.

Regardless of the application method used (sprayer, roller or brush) the Contractor shall be responsible for achieving 100% coverage of the concrete including the interior surfaces of concrete voids, recesses, or other depressions on the concrete surface.

Protect plants, grass, sealant, asphalt, traffic, etc. during application from spray.

515.05 Method of Measurement

Pigmented Concrete Protective Coating will be measured for payment by the square yard, satisfactorily applied and accepted.

515.06 Basis of Payment

Pigmented Concrete Protective Coating will be paid at the Contract unit price per square yard which price shall be full compensation for all labor, materials, equipment and incidentals required for furnishing and applying the pigmented concrete protective coating as shown on the Plans, in accordance with these Specifications or as approved by the Resident.

Surface preparation, including high-pressure washing to remove existing coatings, sandblasting, vegetation removal, and protection of surfaces not designated for treatment will not be measured separately for payment, but shall be incidental to the Pigmented Concrete Protective Coating item.

Providing, cleaning, and coating test area will not be measured separately for payment, but shall be incidental to the Pigmented Protective Coating pay item.

Payment will be made under:

Pay Item		Pay Unit
515.201	Pigmented Protective Coating for Concrete Surfaces	Square Yard

SPECIAL PROVISION

SECTION 515

PROTECTIVE COATING FOR CONCRETE SURFACES

(Clear Concrete Protective Coating)

Section 515, Protective Coating for Concrete Surfaces, is deleted in its entirety and replaced with the following:

515.01 Description

The work shall include the surface preparation and application of a clear protective coating on concrete surfaces to protect new cast-in-place concrete, precast concrete and masonry structures. The coating system shall be applied to endposts, top of sidewalk, concrete parapet, slope protection, culvert headwalls and retaining walls, exposed toll islands, barriers, booth enclosures, bumpers, pedestals, and other exposed concrete surfaces in accordance with the Plans, Specifications and the manufacturer's published recommendations.

515.02 Materials

The penetrating sealer shall be:

Certi-Vex Penseal 244-100%

Type	1c Penetrating Silane
Min. Appl. Temp. (F)	20-90
Silanes (%)	100% silane, alcohol based
VOCs (g\L)	< 250

Sikagard 705L

Type	1c Penetrating Silane
Min. Appl. Temp. (F)	40-95
Silanes (%)	100% silane, alcohol based
VOCs (g\L)	100

SIL-ACT ATS-100 LV Silane

Type	1c Penetrating Silane
Min. Appl. Temp. (F)	40-110
Silanes (%)	100% silane, alcohol based
VOCs (g\L)	< 250

SIL-ACT ATS-300

Type	1c Penetrating Silane
Min. Appl. Temp. (F)	20-110
Silanes (%)	100% silane, solvent based
VOCs (g\L)	242

The product shall comply with regulations limiting the Volatile Organic Compound (VOC) content of architectural and industrial maintenance coatings.

The Contractor shall submit the product's data sheets, material safety data sheets and recommended instructions for application.

Materials shall be delivered to the site in original packages or containers bearing the manufacturer's labels and identification.

515.021 Substitute Materials

The Contractor shall submit a written request for approval of proposed substitute material naming the proposed manufacturer and product. This request shall be accompanied by:

1. Test data from an independent testing laboratory stating that the proposed substitute meets or exceeds the specified requirements as listed and has been tested in accordance with the specified test standards.

2. Documentation that the proposed material has a proven record of performance when used in the intended application as confirmed by actual field tests and successful installations in place on at least five similar projects.

3. Certification that if two or more types of products are intended to be used as part of a system, they will be supplied by the same manufacturer to ensure compatibility of materials, and to maintain single source manufacturer responsibility.

The Resident reserves the right to require additional testing to evaluate any proposed substitute product at no additional cost to the Authority. The Resident's decision as to the acceptability or non-acceptability of the proposed product shall be final.

515.03 Surface Preparation

All caulking, patching, and joint sealant shall be installed prior to application of the sealer. On new surfaces to be treated, all voids shall be dressed by dry rubbing to remove form marks and blemishes to present a neat appearance. Concrete and masonry surfaces shall be cleaned free of dust, surface dirt, oil, efflorescence and contaminants to ensure penetration of the sealer. The surface may be slightly damp at the time of treatment.

The Contractor may use, when required, appropriate cleaning materials recommended by the sealer manufacturer in conjunction with high pressure water for cleaning the concrete or masonry.

515.04 Application

The Contractor shall apply the clear concrete protective coating in strict accordance with the manufacturer's published recommendations.

The work shall not be conducted when there is a chance of the surface temperature falling below minimum allowable temperature in the 24-hours following application; nor should it be applied on hot, windy days.

The treatment shall not be applied during rain to wet surfaces. It shall not be applied when winds are sufficient to carry airborne chemicals. Product shall be cured per the manufacturer's recommendation.

Prior to applying the sealer, the Contractor shall protect all surrounding non-masonry/non-concrete surfaces, landscape and lawn areas, and surfaces not designated for treatment, from contact with the penetrating sealer, and prevent overspray of the penetrating sealer caused by wind drift.

The Contractor shall ensure that all safety equipment, facilities and precautions recommended by the product manufacturer are furnished and/or strictly adhered to.

The sealer material shall be applied in the manner and with the equipment recommended by the product manufacturer. Coverage will vary depending on condition, texture and porosity of the surfaces. Pre-testing is required to determine acceptability of the procedure.

Sealer shall be applied as packaged without dilution or alteration. Sufficient material shall be applied to thoroughly saturate the surface making sure to brush out excess material that does not penetrate.

When the sealer is applied to horizontal surfaces, it shall be applied in a single saturating application with sufficient material and applied so the surface remains wet for one to two minutes before penetration into the concrete. Surface residues, pools and puddles shall be broomed-out thoroughly until they completely penetrate into the surface.

When the sealer is applied to vertical and sloped surfaces, it shall be applied in a "wet-on-wet" application for best results on most porous materials. In the case of extremely dense concrete, it may be necessary to restrict the amount of material applied to one saturating application in order to prevent surface darkening.

515.05 Method of Measurement

Clear Protective Coating for Concrete Surfaces will be measured for payment by the square yard, satisfactorily applied and accepted.

515.06 Basis of Payment

Clear Protective Coating for Concrete Surfaces will be paid at the Contract unit price per square yard which price shall be full compensation for all labor, materials, equipment and incidentals required for furnishing and applying the clear concrete protective coating as shown on the Plans, in accordance with these Specifications or as approved by the Resident.

Surface preparation, vegetation removal, and protection of surfaces not designated for treatment will not be measured separately for payment, but shall be incidental to the Clear Concrete Protective Coating item.

Payment will be made under:

Pay Item		Pay Unit
515.202	Clear Protective Coating for Concrete Surfaces	Square Yard

SPECIAL PROVISION

SECTION 515

PROTECTIVE COATING FOR CONCRETE SURFACES

(Broadcast Sealant for Concrete Surfaces)

Section 515, Protective Coating for Concrete Surfaces, is deleted in its entirety and replaced with the following:

515.01 Description

The work shall include the surface preparation and application of a broadcast sealant on concrete surfaces to the concrete wearing surface of the entry toll plaza slabs and exit toll point slabs. The coating system shall be applied to the slab wearing surface in accordance with the Specifications and the manufacturer's published recommendations.

515.02 Materials

The broadcast sealer shall be one of the following products, or an approved equal:

- T-78 Methyl Methacrylate Crack Sealer, as manufactured by Transpo Industries, Inc.
- KBP 204 P Seal, as manufactured by Kwik Bond Polymers
- MasterSeal 630, as manufactured by BASF

The products shall comply with regulations limiting the Volatile Organic Compound (VOC) content of architectural and industrial maintenance coatings.

The Contractor shall submit the product data sheets, material safety data sheets and recommended instructions for application of the proposed sealer.

Materials shall be delivered to the site in original packages or containers bearing the manufacturer's labels and identification.

515.03 Surface Preparation

Concrete surfaces shall be cleaned to remove dust, surface dirt, oil, laitance, and other contaminants to ensure proper coverage and penetration of the sealer. Surface preparation shall be performed in strict conformance with the manufacturer's published recommendations.

The Contractor shall use cleaning materials and methods recommended by the sealer manufacturer in conjunction with high pressure water for cleaning the concrete.

The resident shall approve the prepared surface prior to applying the sealer.

515.04 Application

The Contractor shall apply the sealer in strict accordance with the manufacturer's published recommendations. If there is a conflict between the manufacturer's recommendations and the restrictions below, the stricter of the two criteria shall apply. Coverage will vary depending on the condition, texture and porosity of the surfaces. A second coat may be required on very porous substrates. Pre-testing is required.

The application shall not be conducted when surface and air temperatures are outside the range recommended by the manufacturer. The work shall not be conducted when there is a chance of the surface and air temperatures falling outside of the recommended temperature range during the appropriate curing time for the air temperature plus four hours.

The treatment shall not be applied during rain, to wet surfaces, or when there is a chance of rain within 24-hours after application. Following any rain fall, allow the concrete to air dry a minimum of 48 hours before applying broadcast sealant. After treatment, surfaces should be protected from rain for not less than 48-hours. Sealant shall not be applied when winds are sufficient to carry airborne chemicals to unprotected surfaces.

Prior to applying the sealer, the Contractor shall protect all surrounding non-concrete surfaces, landscape and lawn areas, and surfaces not designated for treatment, from contact with the penetrating sealer, and prevent overspray of the penetrating sealer caused by wind drift. Provide shielding as necessary to prevent dust, debris, and overspray from striking vehicular traffic.

The Contractor shall ensure that all safety equipment, facilities and precautions recommended by the product manufacturer are furnished and/or strictly adhered to.

Sealer shall be applied as packaged without dilution or alteration from manufacturer's recommended mixing instructions. Sufficient material shall be applied to thoroughly saturate the surface making sure to brush out excess material that does not penetrate.

When the sealer is applied to horizontal surfaces, it shall be applied in a single saturating application with sufficient material and applied so the surface remains wet for one to two minutes before penetration into the concrete. Surface residues, pools and puddles shall be broomed-out thoroughly until they completely penetrate into the surface.

Broadcast sand shall be applied either by hand or mechanical means on the entire treated area of concrete surfaces prior to cure to achieve a uniform coverage. Follow the manufacturer's requirements for the amount of sand per square area. Place the sand as the sealant begins to gel. Placing of the sand before the gelling of the sealant may cause settlement, excessive coating of the sand, and loss of friction characteristics. Additional sand that does not adhere to the sealant shall be brushed off. The surface shall be inspected and approved by the Resident before allowing traffic to resume. An alternative to sand, if the manufacturer's requirements allow, is providing a brushed finish for skid resistance.

515.041 Storage

Store in factory sealed containers of unmixed material at temperatures within the range recommended by the manufacturer away from direct sunlight and sources of heat. Once the container is opened for product use the manufacturer's requirements shall be followed for storage and the product shall not be used if the recommended shelf life is exceeded.

515.05 Method of Measurement

Broadcast Sealant for Concrete Surfaces will be measured for payment by the square yard, satisfactorily applied and accepted.

515.06 Basis of Payment

Broadcast Sealant for Concrete Surfaces will be paid at the Contract unit price per square yard which price shall be full compensation for all labor, materials, equipment and incidentals required for furnishing and applying the sealer, in accordance with these Specifications or as approved by the Resident.

Surface preparation and protection of surfaces not designated for treatment will not be paid for separately, but shall be incidental to the Broadcast Sealant for Concrete Surfaces item.

Payment will be made under:

Pay Item		Pay Unit
515.203	Broadcast Sealant for Concrete Surfaces	Square Yard

SPECIAL PROVISION

SECTION 515

PROTECTIVE COATING FOR CONCRETE SURFACES

(Epoxy Overlay)

515.01 Description

The first paragraph is amended to read:

This special provision describes furnishing and applying two layers of a two-component polymer overlay system in accordance with what is shown on the Plans or as approved by the Resident. The total thickness of the overlay system shall be 1/4 inch.

515.02 Materials

Furnish materials specifically designed for use over concrete. Pre-qualified polymer liquid binders are as follows:

Product Trade Name	Manufacturer or Supplier	Telephone
Mark-163 Flexogrid	PolyCarb, Inc.	(866) 765-9227
Sikadur 22 Lo-mod	Sika Corporation	(248) 569-5665
E-Bond 526 Lo-Mod*	E-Bond Epoxies, Inc.	(954) 566-6555
Propoxy DOT Type III	Unitex	(816) 231-7700
Sure Level Epoxy (J-57)	Dayton Superior	(888) 977-9600
ICO Flexi-Coat	International Coatings, Inc.	(800) 624-8919
Flexolith	Euclid Chemical Co.	(800) 321-7628

*Preferred product for the Authority.

Polymer Resin

The polymer resin base and hardener shall be composed of two-component, 100 percent solids, 100 percent reactive, thermosetting compound with the following properties:

Property	Requirements	Test Method
Gel Time [A]	15 - 45 minutes @ 75° F	ASTM C881
Viscosity [A]	7 - 70 poises	ASTM D2393, Brookfield RVT, Spindle No. 3, 20 rpm
Shore D Hardness [B]	60-75	ASTM D2240
Absorption [B]	1% maximum at 24 hour	ASTM D570
Tensile Elongation [B]	30% - 70% @ 7 days	ASTM D638
Tensile Strength [B]	>2000 psi @ 7 days	ASTM D638
Flexural Strength [B]	>4500 psi @ 7 days	ASTM D790
Chloride Permeability [B]	<100 coulombs @ 28 days	AASHTO T277

[A] Uncured, mixed epoxy binder [B] Cured, mixed epoxy binder

Aggregates

Furnish natural or synthetic aggregates that have a proven record of performance in applications of this type. Furnish aggregates that are non-polishing, clean, free of surface moisture, fractured or angular in shape; free from silt, clay, asphalt, or other organic materials; and meet the following properties and gradation requirements:

Aggregate Properties:

Property	Requirement	Test Method
Moisture Content	≤0.2%	ASTM C566
Hardness	≥6.5	Mohs Scale
Fractured Faces	100% with at least 1 fractured face & 80% with at least 2 fractured faces of material retained on No.16	ASTM 5821

Gradation:

Sieve Size	% Passing by Weight
No. 4	100
No. 8	30 – 75
No. 16	0 – 5
No. 30	0– 1

515.21 Required Properties of Overlay System

The required properties of the overlay system are listed in the table below:

Property	Requirement [A]	Test Method
Minimum Compressive Strength at 8 Hrs. (psi)	1,000 psi @ 8 hours 5,000 psi @ 24 hours	ASTM C 579 Method B, Modified [B]
Thermal Compatibility	No Delaminations	ASTM C 884
Minimum Pull-off Strength	250 psi @ 24 hours	ACI 503R, Appendix A

[A] Based on samples cured or aged and tested at 75°F

[B] Plastic inserts that will provide 2-inch by 2-inch cubes shall be placed in the oversized brass molds.

515.22 Approval of Polymer Overlay System

Submit product data sheets and specifications from the manufacturer, and a certified test report to the Resident for approval.

For materials not pre-qualified, in addition to the above submittals, submit product history/reference projects and a certified test report from an independent testing laboratory showing compliance with the requirements of the specification.

Product data sheets and specifications from the manufacturer consists of literature from the manufacturer showing general instructions, application recommendations/methods, product properties, general instructions, or any other applicable information.

515.23 Construction

Conduct a pre-installation conference with the manufacturer's representative prior to construction to establish procedures for maintaining optimum working conditions and coordination of work. Furnish the Resident a copy of the recommended procedures and apply the overlay system according to the manufacturer's instructions. The manufacturer's representative familiar with the overlay system installation procedures shall be present at all times during surface preparation and overlay placement to provide quality assurance that the work is being performed properly.

Store resin materials in their original containers in a dry area. Store and handle materials according to the manufacturer's recommendations. Store all aggregates in a dry environment and protect aggregates from contaminants on the jobsite.

Surface Preparation

Determine an acceptable shotblasting machine operation (size of shot, flow of shot, forward speed, and/or number of passes) that provides a surface profile meeting CSP 5 according to the International Concrete Repair Institute Technical Guideline No. 03732. If the Resident requires additional verification of the surface preparation, test the tensile bond strength according to ACI 503R, Appendix A of the ACI *Manual of Concrete Practice*. The surface preparation will be considered acceptable if the tensile bond strength is greater than or equal to 250 psi or the failure area at a depth of 1/4 inches or more is greater than 50 percent of the test area. Continue adjustment of the shotblasting machine and necessary testing until the surface is acceptable to the Resident or a passing test result is obtained.

Prepare the entire surface using the final accepted adjustments to the shotblasting machine as determined above. Thoroughly blast cleans with hand-held equipment in any areas inaccessible by the shotblasting equipment. Do not perform surface preparation more than 24-hours prior to the application of the overlay system.

Just prior to overlay placement, clean all dust, debris, and concrete fines from the concrete surface including vertical faces of curbs and barrier walls up to a height of one inch above the overlay with compressed air. When using compressed air, the air stream must be free of oil. Any grease, oil, or other foreign matter that rests on or has absorbed into the concrete shall be removed completely.

The Resident may consider alternate surface preparation methods per the overlay system manufacture's recommendations. The Resident will approve the final surface profile and cleanliness prior to the Contractor placing the epoxy overlay.

Application of the Overlay

Perform the handling and mixing of the epoxy resin and hardening agent in a safe manner to achieve the desired results according to the manufacturer's instructions. Do not apply the overlay system if any of the following exists:

a. Ambient air temperature is below 50°F;
b. Concrete surface temperature is below 50°F;
c. Moisture content in the concrete exceeds 4.5 percent when measured by an electronic moisture meter or shows visible moisture after two-hours when measured in accordance with ASTM D4263;
d. Rain is forecasted during the minimum curing periods listed under C.5;
e. Materials component temperatures below 50°F;
f. Concrete age is less than 28 days unless approved by the Resident.

After the concrete surface has been shotblasted or during the overlay curing period, only necessary surface preparation and overlay application equipment will be allowed on the concrete surface. Begin overlay placement as soon as possible after surface preparation operations.

The polymer overlay shall consist of a two-course application of epoxy and aggregate. Each of the two courses shall consist of a layer of epoxy covered with a layer of aggregate in sufficient quantity to completely cover the epoxy. Apply the epoxy and aggregate per the manufacturer's requirements. Apply the overlay using equipment designed for this purpose. The application machine shall feature positive displacement volumetric metering and be capable of storing and mixing the polymer resins at the proper mix ratio. Disperse the aggregate using a standard chip spreader or equivalent machine that can provide a uniform, consistent coverage of aggregate. First course applications that do not receive enough aggregate before the epoxy gels shall be removed and replaced. A second course applied with insufficient aggregate may be left in place but will require additional applications before opening to traffic.

After completion of each course, cure the overlay per the manufacturer's instructions. Follow the minimum cure times as prescribed by the manufacturer. Remove the excess aggregate from the surface treatment by sweeping, blowing, or vacuuming without tearing or damaging the surface; the material may be re-used if approved by the Resident and manufacturer. Apply all courses of the overlay system before opening the area to traffic. Do not allow traffic on the treated area until directed by the Resident.

After the first layer of coating has cured to the point where the aggregate cannot be pulled out, apply the second layer. Prior to applying the second layer, broom and blow off the first layer with compressed air to remove all loose excess aggregate.

Prior to opening to traffic, clean all debris and polymer from the roadway. If required by the Resident, a minimum of three days following opening to traffic, remove loosened aggregates from the concrete and approach pavement.

Application Rates

Apply the epoxy overlay in two separate courses in accordance with the manufacturer's instructions, but not less than the following rate of application.

Course	Minimum Epoxy Rate [A] (GAL/100 SF)	Aggregate [B] (LBS/SY)
1	2.5	10+
2	5.0	14+

[A] The minimum total applications rate is 7.5 GAL/100 SF.

[B] Application of aggregate shall be of sufficient quantity to completely cover the epoxy.

Minimum Curing Periods

As a minimum, cure the coating as follows:

	Average temperature of concrete surface, epoxy and aggregate components in °F					
Course	60-64	65-69	70-74	75-79	80-84	85+
1	4 hrs.	3 hrs.	2.5 hrs	2 hrs	1.5 hrs.	1 hr.
2 *	6.5 hrs.	5 hrs.	4 hrs.	3 hrs.	3 hrs.	3hrs.

*Cure course 2 for eight hours if the air temperature drops below 60° F during the curing period.

515.05 Method of Measurement

The Authority will measure Epoxy Overlay in area by square yards completed and accepted, in accordance with the Plans.

515.06 Basis of Payment

Payment is full compensation for preparing the surface; for tensile bond testing; for providing the overlay; for cleanup; for sweeping/vacuuming and disposing of excess materials; and for labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
515.23	Epoxy Overlay	Square Yard

SPECIAL PROVISION

SECTION 518

STRUCTURAL CONCRETE REPAIR

(Granite Curb Joint Mortar and Bedding Mortar Repair)

518.01 Description

The following paragraphs are added:

This work shall consist of the removal and replacement of existing deteriorated granite curb joint mortar and granite curb bedding mortar as shown on the Plans and as directed by the Resident.

518.02 Repair Materials

The following paragraph is added:

Mortar shall be an approved salt-resistant epoxy resin mortar or an approved salt-resistant polymer modified cementitious repair mortar.

The following Subsection is added:

518.032 Construction Requirements

For structures where the existing wearing surface is not removed, the Resident will designate areas where the existing granite curb joint mortar is to be repaired.

For structures where the existing wearing surface is removed the Resident will, after the existing wearing surface is removed, designate areas where the existing granite curb joint mortar and the existing granite curb bedding mortar is to be repaired.

In areas designated for granite curb joint mortar repair, the existing granite curb joint mortar shall be removed between curb sections to a minimum depth of 1 inch from the face of curb. Any loose mortar shall also be removed. The repair area shall be repointed with new mortar and tooled concave at the face of curb. The mortar shall be proportioned, mixed, and applied in accordance with the Manufacturer’s recommendations.

In areas designated for granite curb bedding mortar repair, the existing granite bedding mortar shall be removed under the curb to a minimum depth of 1 inch from the face of curb. Any loose mortar shall also be removed. The mortar shall be replaced with new mortar and finished as shown in the Plans. The mortar shall be proportioned, mixed, and applied in accordance with the Manufacturer’s recommendations.

518.10 Method of Measure

The following sentence is added:

Granite Curb Joint Mortar and Bedding Mortar Repair will be measured for payment by the linear foot along the face of the curb, horizontally and vertically, complete and accepted.

518.11 Basis of Payment

The following sentence is added:

Granite Curb Joint Mortar and Bedding Mortar Repair will be paid for at the contract unit price per linear foot, which includes all materials, labor, equipment, and incidentals necessary to complete the work including removal of existing mortar.

Payment will be made under:

Pay Item		Pay Unit
518.39	Granite Curb Joint Mortar and Bedding Mortar Repair	Linear Foot

SPECIAL PROVISION

SECTION 518

STRUCTURAL CONCRETE REPAIR

(Epoxy Injection Crack Repair)

518.01 Description

The following paragraphs are added:

The work includes epoxy injection crack repair as described below.

- Epoxy Injection Crack Repair includes all concrete crack widths equal to or greater than 1/8 inches as identified by the Resident.

518.02 Repair Materials

The following paragraphs are added:

Epoxy injection crack repair shall be completed using a high strength, low viscosity moisture tolerant epoxy resin as recommended by the manufacturer and approved by the Resident. The proposed repair materials shall be from the MaineDOT Qualified Products List and be submitted to the Resident for approval.

The structural properties of all crack repair materials shall meet or exceed the following requirements:

Tensile Strength (@ 7 days)	5,000 psi	ASTM D638
Bond Strength (@ 14 days)	1,000 psi	ASTM C882
Compressive Strength (@ 3 days, 73ºF)	5,000 psi	ASTM D695
Compressive Modulus (@ 7 days)	250 ksi	ASTM D695

Wide cracks (½" +/- and greater) may be repaired with a non-shrink cementitious grout as recommended by the manufacturer. The following product shall be used:

- Underwater Grout as manufactured by Dayton Superior, 1125 Byers Rd, Miamisburg, OH, 45342

The following Subsection is added:

518.071 Placing Epoxy Injection Materials

a. Mix epoxy components per manufacturer's instructions. Review pot life characteristics of combined materials and prepare quantities accordingly;
b. Open all injection ports along the crack and ensure that all injection ports are securely fastened to the concrete substrate;

c. Attach injection device to the lowest port on vertical cracks, or the first port in the series on horizontal cracks;
d. Slowly and under constant pressure, inject the epoxy material into the first port until the epoxy flows out of the next port in the series. While maintaining constant pressure and flow at the first port, close the adjacent port and continue injection process until epoxy flows from the subsequent port in the series, or until no additional epoxy can be injected into the first port.
e. Repeat the above procedure until all ports have been injected.

518.10 Method of Measure

The following paragraph is added:

The quantity of Epoxy Injection Crack Repair will be measured by the linear foot.

518.11 Basis of Payment

The following paragraph is added:

Epoxy Injection Crack Repair will be paid at the Contract unit bid price per linear foot for each repair; which price shall include, but not necessarily be limited to, removal and disposal of materials, cleaning existing concrete, placing, curing and finishing epoxy and all materials, labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
518.40	Epoxy Injection Crack Repair	Linear Foot

SPECIAL PROVISION

SECTION 518

STRUCTURAL CONCRETE REPAIR

(Parapet Joint Repair)

518.01 Description

The following paragraphs are added:

This work shall also consist of the removal and replacement of existing deteriorated parapet joint sealant and preformed joint filler as approved by the Resident. The Contractor shall provide the Resident safe access to all the parapet joints for inspection before this work begins.

The following Subsection is added:

518.032 Construction Requirements

After the Resident has identified the joint repair locations, the Contractor shall remove the existing joint sealant and preformed joint filler to a minimum 1 3/8 inch depth, clean and prepare the concrete surfaces per sealant and filler manufacturer recommendations, and replace the sealant and filler to the edge of concrete with an approved polyurethane-based sealant such as Sikaflex-1a or other product on the MaineDOT approved products list as directed by the Resident.

518.10 Method of Measure

The following sentence is added:

The quantity of Parapet Joint Repair will be measured by the linear foot where the repair occurs.

518.11 Basis of Payment

The following sentence is added:

Parapet Joint Repair will be paid for at the Contract unit price per linear foot, which includes all materials, labor, equipment, and incidentals necessary to complete the work including removal of existing joint sealant and preformed joint filler.

Payment will be made under:

Pay Item		Pay Unit
518.43	Parapet Joint Repair	Linear Foot

SPECIAL PROVISION

SECTION 518

STRUCTURAL CONCRETE REPAIR

(Elastomeric Concrete Header Repair)

518.01 Description

The following paragraph is added:

The work includes placement of Elastomeric Concrete at the deck expansion joints at the North Street Underpass, as shown on the Plans and as directed by the Resident.

518.02 Repair Materials

The following paragraphs are added:

The materials shall be from one of the manufactures on the Maine Department of Transportation Qualified Products List of Elastomeric Concrete.

Products shall be delivered to the site in Manufacturer's original, intact, labeled containers. Products shall be handled and protected as necessary to prevent damage or deterioration during shipment, handling and storage. Products shall be stored in accordance with Manufacturer's instructions.

518.07 Placing Repair Materials

The following paragraph is added:

The installation shall be conducted in strict accordance with the selected manufacturer's recommendations.

518.10 Method of Measurement

The following paragraph is added:

The quantity of Elastomeric Concrete Header Repair will be measured by the cubic foot.

518.11 Basis of Payment

The following paragraphs are added:

Elastomeric Concrete Header Repair will be paid for at the contract unit price per cubic foot, which shall be payment in full for furnishing all materials, labor and equipment, including preparation of the surfaces of the joint in accordance with the manufacturer's recommendations and all incidentals necessary to complete the work. Pavement strip repair adjacent to the elastomeric concrete headers shall be incidental to Elastomeric Concrete Header Repair.

Payment will be made under:

Pay Item		Pay Unit
518.864	Elastomeric Concrete Header Repair	Cubic Foot

SPECIAL PROVISION

SECTION 520

EXPANSION DEVICES – NON MODULAR

(Asphaltic Plug Joint)

520.01 Description

This work consists of furnishing and installing asphaltic plug joint systems at the locations shown on the Plans, in accordance with these Specifications or as directed by the Resident.

This work shall also include having the approved manufacturer provide a qualified technical representative(s) to supervise the installation of the joint systems. The representative(s) shall instruct, train and supervise the Contractor's personnel in the proper methods of installation. All costs associated with this service shall be included in the unit price of the work.

520.02 Submittals

Prior to construction, the Contractor shall submit the following to the Resident for review and approval:

1. Complete and detailed Shop Drawings of asphaltic plug joint system. Shop Drawing shall include information covering materials, their properties, installation procedures, storage and handling requirements, and Materials Safety Data Sheets.

2. The resume of the manufacturer's technical representative, which shall include the representative's experience installing the asphaltic plug joint system along with the names and telephone numbers of contact persons for recent projects where technical assistance was provided.

3. Certified test reports of the asphaltic binder and the plastic compound.

4. Certificate of Compliance for the aggregate.

520.03 Materials

An asphaltic plug joint system from MaineDOT's Qualified Products List for Expansion Devices – Non-Modular (Asphaltic Plug Joints) shall be used.

520.06 Installation

The asphaltic plug joint system shall be installed in accordance with manufacturer's latest instructions and specifications. Manufacturer's representatives shall be present during entire installation to ensure satisfactory results are obtained.

The installation shall be centered over the joint between the approach slab and roadway subgrade as indicated on the Plans. It shall not be installed when ambient or substrate temperatures are below 40°F, when rain is imminent or as directed by the Resident.

Sawcut and remove bituminous concrete and waterproofing membrane to the required blockout dimensions as shown on the Plans so that the bottom of the blockout is level with the top of the approach slab concrete. The blockout area above the approach slab concrete shall be free of asphalt and membrane, and the blockout area over the approach roadway asphalt shall be blast cleaned to be free of loose asphalt debris. The joint area shall be thoroughly dried using hot compressed air immediately prior to applying the asphaltic material. Vertical surfaces of bituminous concrete overlay shall be cleaned to remove all water and cutting dust.

Binder shall be heated to a safe temperature as recommended by manufacturer. Heating kettles shall be equipped with continuous agitation system, temperature controller, calibrated thermometer and double steel jacket with an oil layer in between, to prevent scorching of the binder. During application, the temperature of binder shall be maintained at a minimum of 350°F. It shall be poured into expansion joint openings until it runs over edges.

Aggregate shall be heated in a rotating drum mixer to a minimum of 350°F or as recommended by the manufacturer. The thermoplastic polymeric modified asphalt binder shall be added to the mixer to precoat aggregates.

Coated aggregate shall be placed into blockouts in layers as recommended by the manufacturer. Blockouts shall be overfilled with coated aggregate as required to compensate for compaction. Equipment for compaction shall be as recommended by the manufacturer. Additional thermoplastic polymeric modified asphalt binder shall be screeded over the compacted joint to fill any surface voids.

Top dressing aggregate shall be applied per the manufacturer’s recommendation.

Plastic compound shall be used for repairing overcuts in bituminous concrete. Cleaning, mixing and application shall be in conformance to the manufacturer’s instructions.

Vehicular traffic may pass over finished joints two hours after compaction or as recommended by the manufacturer.

520.07 Method of Measurement

Asphaltic Plug Joint system will be measured by the linear foot along the top surface of installed joints to the limits shown on the Plan. Preparation of surfaces for the proposed joint system including cutting, grinding and cleaning, will not be measured separately for payment, but shall be incidental to the Asphaltic Plug Joint.

520.08 Basis of Payment

Asphaltic Plug Joint system will be paid for at the Contract unit price per linear foot which price shall be full compensation for all labor, materials, equipment and incidentals required for furnishing and installing the Asphaltic Plug Joint system as shown on the Plans, in accordance with these Specifications or as directed by the Resident.

Payment will be made under:

Pay Item		Pay Unit
520.231	Expansion Device – Asphaltic Plug Joint for Crack Control	Linear Foot

SPECIAL PROVISION

SECTION 526

CONCRETE BARRIER

(Temporary Barrier Markers)

526.1 Description

The following paragraphs are added:

This work shall consist of furnishing, installing and maintaining temporary barrier markers on all temporary barrier supplied by the Contractor and the Authority.

526.2 Materials

The following paragraphs are added:

Temporary barrier markers shall be "Big Dog" barrier markers manufactured by Custom Products Corporation, or approved equal. Markers shall be bi-directional with a minimum effective reflective area of 96 square inches (48 square inches each side) as approved by the Resident. The reflectors shall meet MUTCD reflectivity requirements and shall be orange in color.

526.3 Construction Requirements

The following paragraphs are added:

Temporary barrier markers shall be mounted as follows:

1. One on every fourth barrier in tangents and one on every two barriers in tapers, including all barrier furnished by the Contractor.

2. Delineators shall be physically adhered so as to withstand the force of throw from a snow plow.

3. If more than 25% of delineators in any 50 foot section of barrier fall off for any reason, the Contractor will be responsible for reinstalling all the delineators in that run at that their own cost.

4. Contractor is required to submit the installation method for review and approval to the Resident.

526.4 Method of Measurement

The following paragraphs are added:

Temporary barrier markers shall not be measured for payment separately but shall be incidental to the temporary barrier item.

526.5 Basis of Payment

The following paragraphs are added:

Temporary barrier markers shall not be paid for separately but shall be incidental to the temporary barrier item.

SPECIAL PROVISION

SECTION 526

CONCRETE BARRIER

(Temporary Concrete Barrier Type I)

526.01 Description

The following paragraphs are added:

The work also includes supplying connecting pins and furnishing and mounting retro-reflective delineators, per Subsection 526.02 and 526.03.

526.02 Materials

The following paragraphs are added:

f. Delineators shall be bi-directional with a minimum effective reflective area of eight square inches as approved by the Resident. The reflectors shall be methyl methacrylate and the housing of acrylonitrile butadiene styrene. Color shall be in accordance with the MUTCD.

g. Temporary traffic barrier shall be one of the barriers included under FHWA's Roadside Hardware Policy and Guidance for crashworthy longitudinal barriers, at the Contractor's discretion, unless otherwise specified. The type of temporary traffic barrier shall be provided to the Resident Engineer prior to use. All temporary traffic barrier and corresponding connections shall meet, unless otherwise specified in the Plans, Test Level 3 (TL-3) criteria as defined in NCHRP Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH) based on date of manufacture; all temporary concrete barrier manufactured after 12/31/19 shall meet MASH requirements. The appropriate resource shall be determined as described in the MASH publication. The Contractor shall supply the FHWA approval letter, manufacturer approved shop drawings and connection and anchorage details (if applicable), date of manufacture, and catalogue cuts for each barrier type to the resident engineer for approval. The manufacturer's shop drawings shall specify the maximum deflection distance the product is approved for. The Contractor's shop drawing submittal shall specify the available distance between the back or non-roadway side of the barrier to the closet fixed object or edge of open excavation being protected for each location of differing available deflection distance.

526.03 Construction Requirements

The following paragraphs are added:

Concrete barrier placed at roadway low points shall be shimmed on 1" by 2" by 2' long wood planks to allow drainage to pass under the barrier. In addition, the Resident may direct the Contractor to shim the concrete barrier at other locations to provide for proper roadway drainage.

All labor, material, and equipment necessary to shim the barrier will not be measured separately for payment but shall be incidental to the Concrete Barrier.

The removal of concrete barrier from adjacent to the travel lane may be conducted without a lane closure if it is accomplished in accordance with the following requirements:

- Barrier is removed from the trailing end and the workmen and equipment involved in the operation are always behind the barrier. No workmen or equipment shall enter the travel lane.
- Barrier shall be dragged away from the travel lane to at least a 30-degree angle by the use of a cable.
- Barrier shall be lifted no more than six inches while within 10 feet of the travel lane.

Retro-Reflective Delineators shall be mounted as follows:

- One on top of each barrier.
- One on the traffic side of every barrier used in a taper.
- One on the traffic side of every other barrier at regularly spaced intervals and locations.
- Delineators shall be installed on both sides of the barrier if barrier is used to separate opposing traffic.
- Delineators shall be physically adhered to withstand the force of throw from a snowplow.
- If more than 25% of delineators in any 50-foot section of barrier fall off for any reason, the Contractor will be responsible for reinstalling all the delineators in that run at that their own cost.
- Contractor is required to submit the installation method for review and approval to the Resident.

526.04 Method of Measurement

The following paragraphs are added:

Payment for furnishing, installing and maintaining retro-reflective delineators will not be measured for payment separately but shall be incidental to the Temporary Concrete Barrier Pay Item.

Payment will be made under:

Pay Item		Pay Unit
526.301	Temporary Concrete Barrier, Type I	Linear Foot

SPECIAL PROVISION

SECTION 526

CONCRETE BARRIER

(Temporary Concrete Barrier, Type I - Supplied by Authority)

526.01 Description

The following paragraphs are added:

This work shall consist of loading, transporting, setting, resetting, removing, transporting and stacking Temporary Concrete Barrier, Type I – Supplied by Authority. The barrier shall have attachments allowing individual sections to be connected into a continuous barrier.

The work also includes supplying connecting pins and furnishing and mounting retro-reflective delineators, per Subsection 526.02 and 526.03.

Concrete barriers supplied by Authority shall be available at the following location(s):

Maintenance Area		Linear Feet of Barrier
Kennebunk Maintenance Facility	Mile 25.3	9,200
Crosby Maintenance Facility	Mile 45.8, Southbound	9,200

Upon substantial completion of work, the Contractor shall remove and transport the barrier back to its maintenance area of origin. All barrier shall be returned, sorted and stacked according to type in locations directed by the project Resident or maintenance area foreman.

526.02 Materials

The following paragraphs are added:

e. Delineators shall be bi-directional with a minimum effective reflective area of eight square inches as approved by the Resident. The reflectors shall be methyl methacrylate and the housing of acrylonitrile butadiene styrene. Color shall be in accordance with the MUTCD.

526.021 Acceptance

The Resident shall have the authority to accept or reject all Temporary Concrete Barrier, Type I – Supplied by Authority used on the Project that does not meet the requirements of this specification

526.03 Construction Requirements

The following paragraphs are added:

The Contractor shall notify the Resident prior to the scheduled pick-up and delivery of concrete barrier. No barrier shall be removed from or stacked at the Turnpike Maintenance Area without approval of the Resident.

The Contractor shall move and place barrier-utilizing methods that will not damage the barrier. Barrier that is damaged by the Contractor by failing to use proper methods shall be replaced by the Contractor at no additional cost to the Maine Turnpike Authority.

Concrete barrier supplied by the Authority consists of several different styles. Not all barriers may be compatible. The Contractor shall utilize caution when setting barrier to use identical barrier types as adjacent barrier. Non-compatible barrier that cannot be attached together shall be overlapped by a minimum of 10 feet with the blunt end on the non-traffic side of the barrier. This work will not be measured separately for payment, but shall be incidental to the concrete barrier.

Concrete barrier placed at roadway low points shall be shimmed on 1" by 2" by 2' long wood planks to allow drainage to pass under the barrier. In addition, the Resident may direct the Contractor to shim the concrete barrier at other locations to provide for proper roadway drainage. All labor, material, and equipment necessary to shim the barrier will not be measured separately for payment, but shall be incidental to the Concrete Barrier.

The removal of concrete barrier from adjacent to the travel lane may be conducted without a lane closure if it is accomplished in accordance with the following requirements:

1. Barrier is removed from the trailing end and the workmen and equipment involved in the operation are always behind the barrier. No workmen or equipment shall enter the travel lane.
2. Barrier shall be dragged away from the travel lane to at least a 30-degree angle by the use of a cable.
3. Barrier shall be lifted no more than six inches while within 10 feet of the travel lane.

Retro-Reflective Delineators shall be mounted as follows:

4. One on top of each barrier.
5. One on the traffic side of every barrier used in a taper.
6. One on the traffic side of every other barrier at regularly spaced intervals and locations.
7. Delineators shall be installed on both sides of the barrier if barrier is used to separate opposing traffic.
8. Delineators shall be physically adhered so as to withstand the force of throw from a snow plow.
9. If more than 25% of delineators in any 50 foot section of barrier fall off for any reason, the Contractor will be responsible for reinstalling all the delineators in that run at that their own cost.
10. Contractor is required to submit the installation method for review and approval to the Resident.

526.04 Method of Measurement

The following paragraphs are added:

Temporary Concrete Barrier, Type I – Supplied by Authority shall be measured for payment by the lump sum.

The loading, transporting, setting, resetting, removing, transporting, sorting and stacking of the barrier, the furnishing, installation and maintenance of the barrier delineators, and furnishing and installing connector pins will not be measured separately for payment, but shall be incidental to the cost of the Barrier. Temporary storage of Concrete Barrier between construction phases, if required, will not be measured separately for payment, but shall be incidental to the cost of the Barrier. All equipment required to load, unload, transport and stack Concrete Barrier shall be supplied by the Contractor.

Any Barrier lost or damaged by the Contractor shall be replaced by the Contractor at no additional cost to the Authority.

526.05 Basis of Payment

The fifth paragraph is deleted and not replaced.

The following paragraphs are added:

Temporary Concrete Barrier, Type I – Supplied by Authority will be paid for at the Contract lump sum price, complete in place. Such payment shall be full compensation for loading, transporting, setting, resetting, temporary storage, removing, transporting and stacking at the area designated, furnishing all materials, and all other incidentals necessary to complete the work. Temporary Concrete Barrier, Type I – Supplied by Authority and all connecting pins shall remain the property of the Authority, and shall be returned to the Turnpike Maintenance Area as designated in Subsection 526.01.

Payment of Concrete Barrier shall be based on a percentage of the work accomplished during that pay period.

Payment will be made under:

Pay Item		Pay Unit
526.306	Temporary Concrete Barrier, Type I – Supplied by Authority	Lump Sum

SPECIAL PROVISION

SECTION 526

CONCRETE BARRIER

(Concrete Barrier Type I – Stormwater Filter)

526.01 Description

The following sentence is added:

The work also consists of furnishing and installing concrete barrier Type I for use as a weir on the overflow spillway of the Underdrain Soil Filter (USF) Basin as shown on the Plans.

526.02 Materials

The following items are added:

f. Concrete for the USF footing shall be Class B (f'c-3000 psi).

The following Subsection is added:

526.031 Construction Requirements – Concrete Barrier Type I - Stormwater Filter

The overflow weir at each USF Basin overflow spillway, at a minimum, shall consist of two 10 foot section of concrete barrier type I doweled together and set on a continuous concrete footing. The ends of the barrier shall be flush and any projecting material such as steel loops used for connection pins shall be cut off flush with the concrete. The space between the two abutting barriers shall be sealed with non-shrink grout resulting in a continuous 20 foot concrete barrier. The concrete footing shall be constructed on stable compacted soil. The concrete barrier (overflow weir) shall be set level to the elevations shown on the Plans. Wood or other type shims will not be used to level the barrier.

The concrete barrier type I for the USF Basin shall remain on the site at the completion of the Contract.

526.04 Method of Measurement

The following sentence is added:

Concrete Barrier Type I – Stormwater Filter shall be measured for payment by the linear foot of barrier, complete in place.

526.05 Basis of Payment

The fifth paragraph is deleted in its entirety and not replaced. The following paragraph is added:

Concrete Barrier Type I – Stormwater Filter will be paid for at the Contract linear foot price, complete in place. Such payment shall be full compensation for furnishing, transporting and installing concrete barrier, including connecting dowels, non-shrink grout, concrete footing, and all other incidental materials, labor and equipment, required to complete the work.

Payment will be made under:

Pay Item		Pay Unit
526.307	Concrete Barrier Type I – Stormwater Filter	Linear Foot

SPECIAL PROVISION

SECTION 526

CONCRETE BARRIER

(Concrete Barrier – Type A)
(Concrete Barrier – Type C Guardrail Transition Barrier)

526.01 Description

This Section is deleted and replaced with the following:

This work shall consist of the furnishing, constructing, erecting, and setting permanent concrete barrier and associated elements on granular base material in accordance with these Specifications and the lines and grades shown on the Plans or established by the Resident. The length of each precast barrier segment shall be in accordance with the parameters shown on the Plans. The Contractor shall minimize the number of joints in the final barrier assembly to the extent possible.

The work shall also be completed in accordance with Supplemental Specification 502, Structural Concrete, and Standard Specification 534, Precast Structural Concrete, as referenced herein.

The work shall also include the application of Clear Protective Coating for Concrete Surfaces to all concrete surfaces exposed in the final condition in accordance with Special Provision 515.

Concrete Barrier - Type A – Double faced single slope precast concrete barrier 2'-2½" wide at the base, 43½" high and 36" minimum reveal as shown on the Plans. A structural tube and I-beam connection detail is provided at each end.

Concrete Barrier – Type C Guardrail Transition Barrier – Single face single slope precast concrete barrier 1'-9 3/8" wide at the base, 59½" high, and 54" reveal as shown on the Plans. A structural tube and I-beam connection detail is provided at one end.

526.02 Materials

The second paragraph is deleted in its entirety and replaced with the following:

Concrete for precast components shall be Class P in accordance with Supplemental Specifications, Section 502.05, Composition and Proportioning, with a minimum compressive strength of 4,500 psi and an air entrainment of 6.5% ±1%. Self Consolidating Concrete (SCC) mix designs will be considered for approval provided the mix design is in conformance with the proportion limits specified in Supplemental Specification 502.05. The provisions for slump shall be waived for SCC.

Steel components and hardware for barrier connection assemblies shall be in accordance with MaineDOT Standard Specification 504. All barrier connection assemblies shall be hot dip galvanized after fabrication in accordance with ASTM A123 or A153, as applicable.

All reinforcing steel for concrete barrier shall be epoxy coated. Reinforcing steel shall be fabricated and placed in accordance with the Standard Specifications, Section 503.

Reflective delineators for concrete median barrier shall meet the requirements of Special Provision 645, Highway Signing.

Clear Protective Coating for Concrete Surfaces shall be in accordance with Special Provision 515.

526.03 Construction Requirements

The first paragraph, including items "a" through "c," and the second paragraph are deleted and replaced with the following.

The Contractor shall collect any necessary field data to supplement the Plans, including ground survey and field measurements, required for the development of working drawings. The Contractor shall submit working drawings for approval showing the fabrication details of each proposed barrier section as well as layout drawings indicating station to station plan layout of the barrier, the type of barrier proposed at each location, the length of each barrier segment, the quantity of each barrier segment, and the overall length of each barrier run in accordance with Section 105.7, Working Drawings, and Section 526.031, Submittals. Additionally, working drawings for precast elements shall be submitted in accordance with Standard Specification 535.03, Drawings. Relevant field data, survey, and calculations used in the development of the barrier layout shall be included in the working drawing submittal.

All precast components shall be constructed in accordance with the provisions of Standard Specification 534, Section 534.05, Facilities for Inspection, through Section 534.10, Forms, inclusive, as well as Section 534.12, Inserts, through Section 534.20, Installation of Precast Units, inclusive. The provisions of Standard Specification Section 712.061, Structural Precast Concrete Units, exclusive of material requirements, shall apply. Concrete barrier shall not be formed using slip forming methods.

The following paragraphs are added at the end of this section:

f. Sections of barrier shall be uniform in color and in good condition, free from cracked or spalled surfaces.

The layout and placement of the concrete barriers shall be to the alignment and elevations shown on the Plans, approved working drawings, or as directed by the Resident. Before any barrier or transitions may be placed, the subbase shall be compacted to 95 percent density and fine graded to a tolerance of ±1/2 inch of the true grade at any location under the barrier.

All Cast-in-Place barrier adjacent to precast barriers shall include hardware for the barrier connections as detailed in the Plans.

526.031 Submittals

Prior to construction, the Contractor shall submit the following to the Resident for review and approval:

a. Complete and detailed Shop Drawings of each barrier type. Shop drawings shall include information covering materials and their properties, installation procedures, lifting devices, storage and handling requirements, reinforcing layout, protective coating information, geometric dimensions, quantity of pieces, overall length of pieces, and all other information necessary to fabricate the pieces in accordance with the Plans and Specifications.
b. Complete and detailed layouts for all barrier runs. The layouts shall include:
    i. A suitably formatted spreadsheet for each barrier run that includes start and end stations for all Type A barrier runs centered on the Exit 35 Northbound Plaza median.
    ii. The spreadsheet shall also include the quantity and length of all standard and custom pieces of each type in the run. Standard and custom length pieces shall be quantified and included in the Shop Drawing bill of materials. The Contractor shall minimize the number of joints and maximize the number of standard length pieces in the final barrier assembly to the extent possible.
    iii. Contractor is responsible for surveying station locations of fixed points and other necessary features before developing final layout stationing.
    iv. Contractor shall work from fixed points to floating points when developing barrier layout runs. See barrier detail sheets for defined fixed and floating points. Contractor shall submit a proposed construction sequence for the installation of the barrier, including the start and end stations of each barrier run. The floating points shall be used for both maximizing the number of full length pieces as well as building in tolerance when setting the barrier.
    v. The barrier layout spreadsheet shall be formatted and contain stationing and offset information such that the Resident Engineer can check it against the requirements of the Plans and Specifications before and during construction.
c. All comments made by the Resident Engineer shall be addressed by the Contractor. The resolution of all comments shall be tracked, reconciled, and submitted to the Authority for review and verification. Fabrication shall not proceed until written acceptance of the final barrier layout and shop drawings is received by the Contractor from the Authority.

526.04 Method of Measurement

The following paragraphs are added:

Concrete Barrier - Type A, will be measured for payment by the lump sum satisfactorily completed and in place as shown on the Plans.

Concrete Barrier - Type C Guardrail Transition Barrier will be measured by each barrier satisfactorily completed and in place as shown on the Plans.

The application of Clear Protective Coating for Concrete Surfaces will not be measured for payment separately but shall be incidental to the related barrier pay items.

526.05 Basis of Payment

The following paragraphs are added:

The Contract Lump Sum price for Concrete Barrier - Type A shall be full compensation for: shop drawings and layout submittal; field layout; furnishing all materials, supplies, and equipment; reinforcing and casting; delivery; excavation; bedding material; grading; installation; reflective delineators; application of Clear Protective Coating for Concrete Surfaces; and other all incidentals necessary to complete the work.

The unit price for Concrete Barrier - Type C Guardrail Transition Barrier sections shall be full compensation for: shop drawings and layout submittal; field layout; furnishing all materials, supplies, and equipment; reinforcing and casting; delivery; excavation, bedding material grading; installation; reflective delineators; application of Clear Protective Coating for Concrete Surfaces; and other all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
526.351	Concrete Barrier – Type A	Lump Sum
526.368	Concrete Barrier – Type C Guardrail Transition Barrier	Each

SPECIAL PROVISION

SECTION 527

ENERGY ABSORBING UNIT

(Center Barrier Crash Attenuator (Smart Cushion))

527.01 Description

The following sentences are added:

This work shall include furnishing, installing and securing the energy absorbing units as described in the Plan drawings and detailed by the manufacturer. Drawings and general provisions of this Contract, including General Provisions and Special Conditions, apply to work of this section.

527.02 Materials

The energy absorbing system shall be the Smart Cushion as manufactured by Hill & Smith Inc. or an approved equal. Units must be a re-directive, non-gating crash cushion and suitable for installation on a concrete surface. Units shall have the ability to mount to a 2' wide concrete barrier. The energy absorbing units shall be as approved, and crash tested by the Federal Highway Administration. The units shall conform to the MASH Test Level 3 requirements and must be approved by the Resident.

527.03 Construction Requirements

The Contractor shall submit a set of installation drawings to the Resident for approval. The system shall be installed in accordance with the manufacturer's recommendation and the installation drawings.

The Smart Cushion shall be placed on a concrete pad meeting the requirements of the manufacturer's installation drawings. The pavement shall be sawcut to the limits of the concrete pad dimensions prior to installation to ensure the concrete surface matches the adjacent pavement.

One spare unit will be paid for at the Contract unit price which shall include delivery and stacking at the Crosby Maintenance Facility at Mile Marker 45.8 Southbound.

527.04 Method of Measurement

Center Barrier Crash Attenuator (Smart Cushion) will be measured by each unit complete, in place and accepted.

527.05 Basis of Payment

Center Barrier Crash Attenuator (Smart Cushion) will be paid for at the Contract unit price, complete in place and accepted. Payment shall be full compensation for furnishing all labor, equipment, materials and incidentals necessary to complete the work.

All work associated with pavement removal and installation of the concrete pad, including reinforcing steel, shall be considered incidental to Item 527.307.

Connection of the Smart Cushion to the concrete center barrier will not be paid for separately but shall be incidental to Item 527.307.

Payment will be made under:

Pay Item		Pay Unit
527.307	Center Barrier Crash Attenuator (Smart Cushion)	Each

SPECIAL PROVISION

SECTION 527

ENERGY ABSORBING UNIT

(Work Zone Crash Cushion)
(Resetting Existing Work Zone Crash Cushions)

527.01 Description

The first paragraph is deleted in its entirety and replaced with the following:

The Contractor shall furnish and install, or reset work zone crash cushions where shown on the Plans, as specified herein, in Special Provision 652, or as approved by the Resident. Work zone crash cushions are required at each exposed end of temporary concrete barrier or guardrail.

The exposed end of the concrete barrier within 30 feet of the mainline travel lane shall be protected at all times. Barrier shall not be reset until after the work zone crash cushion(s) has been set to protect the exposed end of the barrier.

527.02 Materials

The following paragraph is added:

Work zone crash cushions fabricated prior to December 31, 2019 in serviceable condition shall meet the requirements of NCHRP 350 TL-3 crash test requirements and work zone crash cushions fabricated after December 31, 2019 shall meet the MASH TL-3 crash test requirements for use on the turnpike and local roadways with posted speeds of 45 MPH or greater. Work zone crash cushions fabricated prior to December 31, 2019 shall meet in serviceable condition shall meet the requirements of NCHRP 350 TL-2 crash test requirements and work zone crash cushions fabricated after December 31, 2019 shall meet the MASH TL-2 crash test requirements for use on local roadways with posted speeds of 40 MPH or less. The Contractor shall provide the Resident with documentation of the proposed work zone crash cushion’s MASH Crash Test Results prior to installation at the jobsite.

527.03 Construction Requirements

The following is added to the end of the first paragraph:

The design speeds for work zone crash cushions shall be 45 mph for local road and 70 mph for turnpike roadways unless otherwise noted on the Plans.

527.04 Method of Measurement

Work Zone Crash Cushions used to protect exposed ends of guardrail for steel girder erection will not be measured separately for payment but shall be included under the Maintenance of Traffic for Steel Girder Erection item.

Replacement barrels, after collisions, will be paid for as a percentage of the individual barrels damaged to the total barrels in the complete system. The removal of impacted barrels and debris will be considered incidental to the replacement barrels. Barrels on hand, but unused will not be paid for directly.

Resetting Existing Work Zone Crash Cushion will be measured by the Unit, complete in place and accepted.

527.05 Basis of Payment

Resetting Existing Work Zone Crash Cushion will be measured by the Unit, complete in place and accepted.

Payment will be made under:

Pay Item		Pay Unit
527.341	Work Zone Crash Cushions – TL-3	Unit
527.342	Work Zone Crash Cushions – TL-2	Unit
527.343	Resetting Existing Work Zone Crash Cushion	Unit

SPECIAL PROVISION

SECTION 602

PIPE LINING

(Pumped Grout Fill)

602.01 Description

This work shall consist of furnishing all labor, equipment, and materials to place Pumped Grout Fill into abandoned underground pipes at the locations designated on the Plans. The material shall be capable of flowing over long distances without segregation or separation of the grout materials.

602.02 Materials

Materials shall conform to the requirements specified in the following Subsections of Division 700 — Materials:

▪ Portland Cement	701.01
▪ Water	701.02
▪ Fly Ash	701.10
▪ Fine Aggregate	703.01
▪ Chemical Admixtures	701.04

Pumped Grout Fill shall meet the following properties:

Range of Cast Density, PCF	65 minimum
Compressive Strength, PSI	110 – 500

602.03 Submittals

- The Contractor shall submit a mix design for Pumped Grout Fill for review and approval prior to installation. The mix design, at a minimum, shall include materials to be used with source information, batch tests or historical test data if reusing a mix design, targets for grout density, water cement ratio, 28-day compressive strength, and air content.
- The contractor shall submit a placing plan that provides equipment and placement methods, for review and approval prior to placing. The plan shall include: equipment specifications that demonstrate sufficient capacity to place grout in a single operation, pumping port and air vent locations, target pumping pressure, description of how the pipe end bulkheads will be formed to contain and support the pumped grout, and testing procedure(s).

602.04 Placing Pumped Grout Fill

Pumped Grout Fill shall not be placed until bulkhead forms, pump injection port(s), and air vent(s) have been checked and approved.

Pumped Grout Fill shall be placed before it has taken its initial set and shall be placed in such a manner as to avoid separation and segregation of the grout materials.

Placement of Pumped Grout Fill to fill abandoned pipes shall require a pressurized pump system with PVC piping for adequate air venting. A gauge to monitor grout pressure shall be attached immediately adjacent to each injection port. Threaded injection ports shall be suitable to withstand maximum pumping pressures. A minimum of one air vent shall be installed on the upstream bulkhead form to ensure the abandoned pipe is filled in its entirety.

Unit weight density tests may be taken at the discretion of the Resident to confirm the cast density.

602.05 Method of Measurement

Pumped Grout Fill satisfactorily placed and accepted will be measured by the cubic yard based on the volume of the pipe.

602.06 Basis of Payment

The accepted quantity of Pumped Grout Fill will be paid for at the Contract unit price per cubic yard. Payment will be full compensation for furnishing and placing Pumped Grout Fill, including all labor, materials, equipment, bulkhead formwork, pumping ports and vents, dewatering and necessary incidentals.

Payment will be made under:

Pay Item		Pay Unit
602.40	Pumped Grout Fill	Cubic Yard

SPECIAL PROVISION

SECTION 603

PIPE CULVERTS AND STORM DRAINS

(Corrugated Metal Pipe)
(Reinforced Concrete Pipe)
(Concrete Collar)
(Corrugated Polyethylene Pipe)

603.01 Description

The following paragraphs are added:

This work shall also consist of furnishing and installing Class III or Class V reinforced concrete pipe at the locations as shown on the Plans or as approved by the Resident.

This work also consists of furnishing and installing a concrete collar to join existing concrete pipe to the proposed concrete or Corrugated High Density Polyethylene (HDPE) pipe in accordance with the details as shown on the Plans. The Contractor shall note that the pipe ends may be of different sizes and may not fit snugly together.

This work shall also consist of furnishing and installing various sizes of corrugated HDPE pipe, including a dual wall adaptor fitting by Hancor or an approved equal as shown on the plans. No other pipe types within the Option III alternatives will be accepted.

603.02 Materials

All Corrugated High Density Polyethylene (HDPE) pipe for storm water and drainage systems shall meet the requirements of Subsection 706.06.

603.11 Method of Measurement

The following paragraph is added:

The Concrete Collar shall be measured by each unit installed, complete in place and accepted. This shall be full compensation for furnishing labor and materials to construct a Concrete Collar to connect the existing and proposed pipe ends in a working like manner.

Dual Wall Adapter Fitting shall be included for payment as three additional linear feet of the largest pipe involved.

603.12 Basis of Payment

Concrete Collars will be paid for at the Contract unit price each regardless of the size of the existing and proposed pipes.

Corrugated HDPE pipe will be paid for under the appropriate sized Culvert Pipe Option III pay items

Payment will be made under:

Pay Item		Pay Unit
603.151	12 Inch Corrugated Metal Pipe	Linear Foot
603.155	12 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.1553	12 Inch Reinforced Concrete Pipe – Class V	Linear Foot
603.165	15 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.1653	15 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.175	18 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.1753	18 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.195	24 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.1953	24 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.205	30 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2053	30 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.215	36 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2153	36 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.225	42 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2253	42 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.235	48 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2353	48 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.245	54 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2453	54 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.255	60 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2553	60 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.265	66 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2653	66 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.275	72 Inch Reinforced Concrete Pipe - Class III	Linear Foot
603.2753	72 Inch Reinforced Concrete Pipe - Class V	Linear Foot
603.28	Concrete Collar	Each
603.285	84 Inch Reinforced Concrete Pipe – Class III	Linear Foot

SPECIAL PROVISION

SECTION 604

MANHOLES, INLETS AND CATCH BASINS

604.01 Description

This Subsection is amended by the addition of the following:

The Type II work shall consist of rebuilding catch basins as specified in the Specifications to grade, removing the existing unsound concrete, frame and grate, applying a bead of Elastomeric sealer to the frame seat and reinstalling the existing grate in accordance with these Specifications and in reasonable close conformity with the lines and grades as shown on the Plans.

The Type IV work shall consist of rebuilding catch basins as specified in the Specifications to grade, removing the existing unsound concrete, frame and grate, and reinstalling the existing frame and grate in accordance with these Specifications and in reasonable close conformity with the lines and grades as shown on the Plans.

Brick and mortar shall NOT be used to set frames, alter, adjust, or rebuild catch basins and manholes; concrete shall be used.

The work locations are listed on the Drainage Summary sheets of the Plans.

604.02 Materials

The following sentences are added:

Elastomeric sealer shall be Sikaflex 1a as manufactured by Sika or an approved equal.

Class AAA concrete shall conform to Subsection 502.05; except that the minimum cement factor shall be 750 pounds per cubic yard and the coarse aggregate size shall conform to ASTM C33 Grading 7.

The third paragraph should be deleted in its entirety and replaced with:

Catch Basin Frames and Grates shall be as outlined below and be manufactured by EJ Company of Brockton, Massachusetts or an approved equal and shall meet or exceed the AASHTO M306 Loading Requirements.

Catch Basin Frames shall be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product numbers:

5521Z – 8 Inch Frame Product Number 00552111
5546Z – 6 Inch Frame Product Number 00554611
5544Z – 4 Inch Frame Product Number 00554411

Catch Basin Frames shall be 8" frames unless otherwise specified by the plans or approved by the resident.

Catch Basin Grates shall be a square holed grate as manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product number:

5520M5 Grate Product Number 00552060

If a cascade catch basin grate is specified on the plans then it shall be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product numbers depending on the direction of flow:

5520M8 Product Number 00552084 or 5520M8 Product Number 00552085

604.04 Altering, Adjusting, and Rebuilding Catch Basins and Manholes

This Subsection is deleted and replaced with the following:

When adjusting the existing catch basins they shall be dismantled sufficiently to allow reconstruction in accordance with the following requirements and as shown on the Plans:

Brick and mortar shall NOT be used to set frames, alter, adjust, or rebuild catch basins and manholes; concrete shall be used.

Any frame or grate damaged by the Contractor's operations shall be replaced by the Contractor at no additional cost to the Authority. Replacement frame and grate shall meet the requirements of Subsection 604.02. Damaged frames and grates shall become the property of the Contractor and shall be removed from Turnpike property.

Rebuild Catch Basin to Grade – Type II

The existing frame and grate shall be removed, stacked and reset. Remove all unsound concrete and anchor rods shall be removed to sound concrete as determined by the Resident. Install four Number 4 dowels, twelve inches in length, in each sidewall, reform catch basin to necessary grade using Class AAA concrete. The existing frame shall be reinstalled to the pavement grade as determined by the Resident.

Prior to installation of the grate, the frame shall be cleaned to accept a bead of elastomeric sealer. Sealer shall be placed in a continuous bead over the horizontal surface in accordance with the manufacturer's recommendation. The existing grate shall be reinstalled and allowed to set for a minimum of 1 ½-hour before receiving traffic loads.

Rebuild Catch Basin to Grade – Type IV

The existing frame and grate shall be removed, stacked and reset. Remove all unsound concrete and anchor rods to sound concrete as determined by the Resident. Install four Number 4 dowels, twelve inches in length, in each sidewall, reform catch basin to necessary grade using Class AAA concrete. Reinstall the existing frame and grate to the finished grade as designated by the

Resident and construct a bituminous concrete waterway including regrading (raising) the drainage swale with gravel borrow.

The Contractor shall remove unsound concrete (two inches minimum) from the existing floor slab and replace if directed by the Resident. Existing sumps shall be retained in the basin. Prior to placement of the concrete, the catch basin floor and walls shall be cleaned of all debris, loose and foreign materials to the satisfaction of the Resident.

604.05 Method of Measurement

The following are added after Subsection e. Grate:

Rebuild Catch Basin to Grade – Type II will be measured for payment by each unit rebuilt, secured and accepted.

Rebuild Catch Basin to Grade – Type IV will be measured for payment by each unit rebuilt, and accepted.

Each unit includes removing and replacing a depth up to 12 inches from the bottom of the frame to the top of sound concrete in the wall. Each six inches of concrete removed and replaced over 12 inches will be measured for payment as one eighth (1/8) of a unit. Depth measurements in excess of the dimensions authorized will not be included.

604.06 Basis of Payment

The following paragraphs are added after the first paragraph:

The accepted quantity of Rebuild Catch Basin to Grade – Type II will be paid for at the Contract unit price each. This price shall be full compensation for removing existing frame and grate, rebuilding the catch basin top to grade, reinstalling the existing frame, cleaning the horizontal surface, applying the elastomeric sealer, reinstalling the existing grate, and all other labor, equipment and materials required to complete the work.

The accepted quantity of Rebuild Catch Basin to Grade – Type IV will be paid for at the Contract unit price each. This price shall be full compensation for removing existing frame and grate, rebuilding the catch basin top to grade, reinstalling the existing frame and grate, and all other labor, equipment and materials required to complete the work.

The second paragraph is deleted and replaced with the following:

Excavation and backfill will not be measured separately for payment, but shall be incidental to the following pay items.

Bituminous concrete waterways shall be paid for under Item 459.06 or 459.061.

Sawing bituminous pavement will not be measured separately for payment, but shall be incidental to the related drainage items.

Payment will be made under:

Pay Item		Pay Unit
604.073	Catch Basin Type A1	Each
604.184	Rebuild Catch Basin to Grade – Type II	Each
604.186	Rebuild Catch Basin to Grade – Type IV	Each
604.263	60” Catch Basin Type B5	Each

SPECIAL PROVISION

SECTION 604

MANHOLES, INLETS, AND CATCH BASINS

(Secure Catch Basin Grate)

604.01 Description

This work shall consist of removing existing catch basin grates in the existing four foot paved shoulder, or other locations noted on the plans, cleaning existing frames, furnishing and applying elastomeric sealer to frame seats, and furnishing and installing new grates. This work shall be completed prior to opening paved shoulders to traffic.

604.02 Materials

The following sentences are added:

Catch Basin Grates shall be a square holed grate meeting or exceed the AASHTO M306 Loading Requirements and be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product number:

5520M5 Grate Product Number 00552060 (170-pound weight)

Elastomeric sealer shall be Sikaflex 1a as manufactured by Sika or an approved equal.

604.03 Construction Requirements

The following paragraphs are added:

After removal of an existing grate, the frame shall be cleaned to accept elastomeric sealer. Sealer shall be placed in a continuous bead over horizontal and vertical surfaces in accordance with the manufacturer's recommendations. Installed grates shall be preloaded and allowed to set for a minimum of 1.5-hours before receiving traffic loads to assure adequate adhesion of the sealer. The old grates shall be transported to the Crosby Maintenance Area Mile 45.8 Southbound and stacked at a location designated by the Resident. Old grates shall remain the property of the Authority.

New grates shall remain in place at the completion of construction and shall become the property of the Maine Turnpike Authority.

The Contractor is required to have two additional grates on-site at all times for use as backup devices. Unused grates shall become the property of the Authority and shall be stacked at Crosby Maintenance Area Mile 45.8 Southbound.

604.05 Method of Measurement

The following sentence is added:

Secure Catch Basin Grate will be measured for payment by each unit secured and accepted.

604.06 Basis of Payment

The following paragraphs are added:

The accepted quantity of Secure Catch Basin Grate will be paid for at the Contract unit price each. This price shall be full compensation for removing the existing grate, cleaning the horizontal and vertical surfaces, applying the elastomeric sealer, furnishing and installing the new grate, transporting and stacking the old grate, and all other labor, equipment, and materials required to complete the work.

Unused backup grates stacked at Crosby Maintenance Area Mile 45.8 Southbound will be paid for at the Contract unit price each under the Secure Catch Basin Grate item.

Payment will be made under:

Pay Item		Pay Unit
604.40	Secure Catch Basin Grate	Each

SPECIAL PROVISION

SECTION 604

MANHOLES, INLETS AND CATCH BASINS

604.02 Materials

The following sentences are added:

Elastomeric sealer shall be Sikaflex 1a as manufactured by Sika or an approved equal.

Class AAA concrete shall conform to Subsection 502.05; except that the minimum cement factor shall be 750 pounds per cubic yard and the coarse aggregate size shall conform to ASTM C33 Grading 7.

The third paragraph should be deleted and replaced with:

Catch Basin Frames and Grates shall be as outlined below and be manufactured by EJ Company of Brockton, Massachusetts or an approved equal and shall meet or exceed the AASHTO M306 Loading Requirements.

Catch Basin Frames shall be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product numbers:

5521Z – 8 Inch Frame Product Number 0552111
5546Z – 6 Inch Frame Product Number 0554611
5544Z – 4 Inch Frame Product Number 00554411

Catch Basin Frames shall be 8" frames unless otherwise specified by the plans or approved by the resident.

Catch Basin Grates shall be a square holed grate as manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product number:

5520M5 Grate Product Number 00552060 (170-pound weight)

If a cascade catch basin grate is specified on the plans then it shall be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product numbers depending on the direction of flow:

5520M8 Product Number 00552084 (170-pound weight) or 5520M8 Product Number 00552085 (170-pound weight)

If a beehive catch basin grate is specified on the plans then it shall be manufactured by EJ Company of Brockton, Massachusetts (or an approved equal) with the following product:

1045Z – Product Number 00104045C02

604.03 Construction Requirements

The following paragraphs are added:

The beehive catch basin frame shall be installed on the exposed catch basin structure in the underdrained soil filter basins using stainless steel hardware on the quarter-points of the frame to secure the frame to the structure. Stainless steel hardware shall consist of ½ inch diameter stainless steel expansion wedge anchor bolt, washer, and nut. The anchor bolt shall be embedded 3 inches into the structure. If the frame is ordered without holes, the contractor shall drill 5/8" diameter holes in the frame flange on quarter-points.

Bricks shall not be used to adjust frames to grade, only use of concrete riser rings will be permitted.

SPECIAL PROVISION

SECTION 605

UNDERDRAIN

(PVC Underdrain)

605.01 Description

The following paragraph is added:

This work shall consist of the construction of underdrain for the stormwater filter system using pipe and bedding material in accordance with these Specifications and in reasonably close conformity with the lines and grades on the Plans.

605.02 Materials

The following paragraphs are added:

Material for six inch PVC Underdrain (laterals) shall conform to the requirements of AASHTO M278 or ASTM F949.

Material for eight inch PVC Underdrain (header/outlet pipe) shall conform to Subsection 706.08, PVC Pipe.

Underdrain Type B bedding material shall be well graded, clean, coarse gravel, free from organic matter and meeting Subsection 703.22, Type B with no more than two percent by weight passing the #200 sieve.

End caps for orifices shall be mechanically fastened to the outlet pipe.

605.04 Underdrain Construction

The following paragraphs are added:

The underdrain system to be installed as part of each stormwater filter consists of a series of parallel six inch PVC lateral underdrain pipes connected to an eight inch PVC underdrain header/outlet pipe as shown on the Plans. The underdrain pipe system shall be surrounded by underdrain bedding. A drainage geotextile (as specified in Section 620) shall be placed below the underdrain bedding on a graded, compacted and level base. Drainage geotextile shall also extend vertically along the walls of the underdrain bedding (and also extend vertically along the wall of the Soil Filter). A PVC underdrain cleanout shall be located at the upstream end of the eight inch PVC underdrain header/outlet pipe.

605.06 Method of Measurement

The following paragraphs are added:

All elbows, tees, wyes, or other special fittings required for connecting and fabricating underdrain for the stormwater filter system will not be measured.

605.07 Basis of Payment

The following paragraphs are added:

Payment for 6 Inch PVC Underdrain and 8 Inch PVC Underdrain will be made at the Contract unit price per linear foot in place. Payment will be full compensation for furnishing and placing bedding, 8 Inch and 6 Inch PVC Underdrain, all fittings and connections, cutting and connecting the underdrain, drilling orifice holes, and all labor and equipment necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
605.016	6 Inch PVC Underdrain	Linear Foot
605.018	8 Inch PVC Underdrain	Linear Foot

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks, Single Faced)
(31" W-Beam Guardrail – Mid-way Splice (8' Steel Posts, 8" Offset Blocks, Single Faced)
(31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks, Double Faced)
(31" W-Beam Guardrail – Mid-way Splice – 15' Radius & Less)
(31" W-Beam Guardrail – Mid-way Splice – Over 15' Radius)

606.01 Description

The section is amended by the addition of the following:

This work shall consist of furnishing and installing guardrail components the required locations in accordance with the Specifications and in reasonably close conformity with the lines and grades shown on the Plans. The types of guardrail are designated as follows:

31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks)
31" W-Beam Guardrail – Mid-way Splice (8' Steel Posts, 8" Offset Blocks)

606.02 Materials

The section is amended by the addition of the following:

Steel posts shall be 7 feet or 8 feet long as specified in the plans.

The guardrail elements shall be per the Components' List found on Sheet No. 2 of 2 of draft Drawing SGR47 – 31" W-Beam Guardrail with Standard 8" Offset Block in the Task Force 13 Report noted above and/or as noted in the Contract Documents unless noted otherwise.

606.04 Rails

The section is amended by the addition of the following:

Height of top of rail shall be 31" measured from final grade. Height transition from 31" W-Beam, mid-spliced guardrail to existing guardrail shall occur over a 25' length.

606.08 Method of Measurement

The section is amended by the addition of the following:

31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks), 31" W-Beam Guardrail – Mid-way Splice (8' Steel Posts, 8" Offset Blocks), 31" W-Beam Guardrail – Mid-way Splice – 15' Radius & Less, and 31" W-Beam Guardrail – Mid-way Splice – Over 15' Radius will be paid for at the contract unit price per linear foot of rail satisfactorily installed and accepted.

606.09 Basis of Payment

The section is amended by the addition of the following:

The accepted quantity of 31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks), 31" W-Beam Guardrail – Mid-way Splice (8' Steel Posts, 8" Offset Blocks), 31" W-Beam Guardrail – Mid-way Splice – 15' Radius & Less, and 31" W-Beam Guardrail – Mid-way Splice – Over 15' Radius will be paid for at the contract unit price per linear foot of rail and shall be full compensation for furnishing all labor, equipment and materials necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
606.13	31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks, Single Faced)	Linear Foot
606.1303	31" W-Beam Guardrail – Mid-way Splice (15' Radius & Less)	Linear Foot
606.1304	31" W-Beam Guardrail – Mid-way Splice (Over 15' Radius)	Linear Foot
606.131	31" W-Beam Guardrail – Mid-way Splice (8' Steel Posts, 8" Offset Blocks, Single Faced)	Linear Foot
606.132	31" W-Beam Guardrail – Mid-way Splice (7' Steel Posts, 8" Offset Blocks, Double Faced)	Linear Foot

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(31” W-Beam Guardrail – Mid-way Splice Flared Terminal)

606.01 Description

The following sentences are added:

This work shall consist of furnishing and installing a MFLEAT (MASH-compliant Flared Energy Absorbing Terminal) for use with the 31” W-Beam Guardrail – Mid-way Splice (7’ Steel Posts, 8” Offset Blocks, Single Faced) as manufactured by Road Systems, Inc., 3616 Old Howard County Airport Road, Big Spring, Texas 79720, (432) 263-2435, and retroreflective adhesive sheeting in accordance with these Specifications and the manufacturer’s installation instructions, and in reasonably close conformity with the lines and grades as shown on the Plans or as approved by the Resident.

606.02 Materials

The following sentence is added:

31” W-Beam Guardrail – Mid-way Splice Flared Terminal components shall be comprised of those shown in the manufacturer’s installation instructions. 8” blocks shall be used.

Reflective sheeting shall meet the requirements of Subsection 719.01, Reflective Sheeting – minimum ASTM Type XI; 3M™ Diamond Grade™ DG³ Reflective Sheeting Series 4000 or approved equal. The color for the reflective sheeting shall be silver (white) when installed on the right shoulder and shall be black chevron on yellow background only when installed on the left shoulder.

The following Subsections are added:

606.045 Offset Blocks

8” Non-wood offset blocks shall be used.

606.035 Construction Requirements

The Contractor shall submit a set of installation drawings to the Resident for approval. The system shall be installed in accordance with the manufacturer’s recommendation and the installation drawings.

A reflective adhesive sheeting shall be applied to the nose of the MFLEAT System after installation.

606.041 Reflective Sheeting

The color for the reflective sheeting shall be silver (white) when installed on the right shoulder and shall be black chevron on yellow background only when installed on the left shoulder.

606.08 Method of Measurement

The second paragraph is amended by the addition of: "31" W-Beam Guardrail – Mid-way Splice Flared Terminal, " after the words "Terminal section, ".

606.09 Basis of Payment

The first paragraph is amended by the addition of: "31" W-Beam Guardrail – Mid-way Splice Flared Terminal, " after the words "Terminal section, ".

The second paragraph is amended by the addition of: ", 31" W-Beam Guardrail – Mid-way Splice Flared Terminal, " after the words "NCHRP 350 end treatments ".

The retroreflective sheeting will not be measured separately for payment but shall be incidental to the 31" W-Beam Guardrail – Mid-way Splice Flared Terminal item.

Payment will be made under:

Pay Item		Pay Unit
606.1307	31" W-Beam Guardrail – Mid-way Splice Flared Terminal	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(31" W-Beam Guardrail – Mid-way Splice Terminal End – Anchored End)
(31" W-Beam Guardrail – Mid-way Splice Terminal End – Anchored End, Double Faced)

606.01 Description

The section is amended by the addition of the following:

This work shall consist of furnishing and installing Terminal End – Anchored End – 31" W-Beam Guardrail end treatment in accordance with these Specifications and Plan Sheet details, the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report: A Guide to Standardized Highway Barrier Hardware, Drawing SEW31 in AASHTO Manual for Assessing Safety Hardware (MASH) approval letter B-256; and in reasonably close conformity with the lines and grades as shown on the Plans or as approved by the Resident.

This work shall consist of furnishing and installing Terminal End – Anchored End, Double Faced – 31" W-Beam Guardrail end treatment in accordance with these Specifications and Plan Sheet details, the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report: A Guide to Standardized Highway Barrier Hardware, Drawing SEW31 in AASHTO Manual for Assessing Safety Hardware (MASH) approval letter B-256; and in reasonably close conformity with the lines and grades as shown on the Plans or as approved by the Resident.

606.02 Materials

The following sentences are added:

The guardrail elements shall be per the Components' List found on Sheet No. 2 & 3 of 3 of Drawing SEW31 – Trailing-end Anchorage System in the Task Force 13 Report noted above and/or as noted in the Contract Documents. The component RWM14a shall be modified to a length of 9'-4½" measured from the center of the Mid-way Splice to the center of the last guardrail post.

606.042 Terminal End - Anchored End

The following sentences are added:

Installation of the Terminal End – Anchored End - 31" W-Beam Guardrail end treatment shall be in accordance with these plans and specifications, the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report and the Details on Sheet No. 1 of 3 of Drawing SEW31 – Trailing-End Anchorage System.

606.043 Terminal End - Anchored End, Double Faced

The following sentences are added:

Installation of the Terminal End – Anchored End, Double Faced - 31" W-Beam Guardrail end treatment shall be in accordance with these plans and specifications, the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report and the Details on Sheet No. 1 of 3 of Drawing SEW31 – Trailing-End Anchorage System.

606.08 Method of Measurement

The second paragraph is amended by the addition of: ", Terminal End - Anchored End – 31" W-Beam Guardrail, Terminal End – Anchored End, Double Faced, 31" W-Beam Guardrail, " after the words "Terminal section,".

606.09 Basis of Payment

The first paragraph is amended by the addition of: ", Terminal End - Anchored End – 31" W-Beam Guardrail, Terminal End – Anchored End, Double Faced, 31" W-Beam Guardrail, " after the words "Terminal section, ".

The second paragraph is amended by the addition of: ", Terminal End - Anchored End – 31" W-Beam Guardrail, Terminal End – Anchored End, Double Faced, 31" W-Beam Guardrail, and " after the words "NCHRP 350 end treatments ".

Payment will be made under:

Pay Item		Pay Unit
606.1351	31" W-Beam Guardrail – Mid-way Splice Terminal End – Anchored End	Each
606.1352	31" W-Beam Guardrail – Mid-way Splice Terminal End – Anchored End, Double Faced	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Bridge Transition- Type III)
(Bridge Transition- Type III, Modified)

606.01 Description

The following sentence is added:

This work shall consist of furnishing and installing Type III Bridge Transitions and Type III, Modified Bridge Transitions at bridge endposts on bridges over the turnpike as shown in the Contract Documents.

The following Subsection is added:

606.071 Guardrail Attachments at Bridges

Bridge transition - Type III, and Bridge Transition - Type III, Modified shall be used at bridge endpost locations as shown on the plans.

606.08 Method of Measurement

The following sentence is added:

Bridge transition - Type III will be measured by each unit of the type specified, installed and accepted.

Bridge Transition- Type III, Modified will be measured by each unit of the type specified, installed and accepted.

606.09 Basis of Payment

The following paragraphs are added:

Bridge Transition - Type III, and Type III, Modified, will be paid for at the Contract unit price each complete in place and shall be full compensation for furnishing all labor, equipment and materials necessary to complete the work consisting of, but not necessarily limited to, the following: furnishing and installing guardrail, modifications to concrete end wall to accept terminal anchor, one terminal connector, precast concrete transition curb, including terminal connector anchorage and all other detailed accessories; furnishing and installing all required posts, rails, offset brackets, back-up plates, nuts, bolts, washers, and all other items necessary to make for a complete installation as shown on the Plans or as approved by the Resident.

Payment will be made under:

Pay Item		Pay Unit
606.1723	Bridge Transition - Type III	Each
606.1724	Bridge Transition - Type III, Modified	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Terminal End – Anchored End, Thrie Beam)

606.01 Description

The following sentence is added:

This work shall consist of furnishing and installing Terminal End - Anchored End, Thrie Beam end treatments in accordance with these Specifications, the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report: A Guide to Standardized Highway Barrier Hardware, dated May 1995; and in reasonably close conformity with the lines and grades as shown on the Plans or as approved by the Resident.

606.02 Materials

The following sentences are added:

The guardrail elements shall be per the Components' List found on Sheet No. 2 of 2 of Drawing SEW02a – Trailing End Terminal – Foundation Tube Option in the Task Force 13 Report noted above and/or as noted in the Contract Documents.

The following Subsection is added:

606.042 Terminal End - Anchored End

Installation of the Terminal End – Anchored End shall be in strict accordance with the AASHTO-AGC-ARBTA Joint Committee Task Force 13 Report and the Details on Sheet No. 1 of 2 of Drawing SEW02a – Trailing End Terminal – Foundation Tube Option.

Height of installation of Terminal End – Anchored End, Thrie Beam units shall be 32.0-inches to the top of rail, transitioning to the standard height of 30-inches over a 25-foot length of Type 3d rail located immediately after the last post of the Thrie Beam Anchored End unit.

The reveal on the soil tube for the Anchored End units shall not exceed 3.5-inches. If site grading is required to achieve the required rail height and soil tube reveal height, then such work will be incidental to the installation of the Anchored End units

606.08 Method of Measurement

The second paragraph is amended by the addition of: ", Terminal End – Anchored End, Thrie Beam," after the words "terminal end."

606.09 Basis of Payment

The first paragraph is amended by the addition of: ", Terminal End - Anchored End, Thrie Beam," after the words "Terminal section."

Payment will be made under:

Pay Item		Pay Unit
606.279	Terminal End - Anchored End, Thrie Beam	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Reflectorized Beam Guardrail Delineator)

606.01 Description

The following paragraphs are added:

Reflectorized beam guardrail delineators shall be installed on existing guardrail to remain in place, guardrail noted to be removed, modified and reset (single and/or double rail) or new guardrail, at the locations noted on Maintenance of Traffic plans or as approved by the Resident. The delineators shall be installed prior to traffic being shifted closer to the identified guardrail run. The color for the reflective sheeting shall be silver (white) when installed on the outside shoulder and yellow when installed on the inside shoulder.

Reflectorized beam guardrail delineators shall be mounted as follows:

1. Delineators on guardrail adjacent to a shifted detour should be spaced every other guardrail post and located at the bolt in the valley of the guardrail beam.

2. On existing steel bridge rail, the delineators shall be mechanically attached towards the top, every 10 feet, and bottom, every 20 feet. Delineators shall also be mechanically attached in a similar pattern to concrete endposts that are 10 feet or longer.

3. If more than 25% of delineators in any 50 feet of guardrail, bridge rail, or endposts fall off for any reason, the Contractor will be responsible for reinstalling all delineators in that run at that their own cost.

4. In no instance shall delineators be installed on guardrail which deviates substantially from the alignment (horizontal or vertical) of the roadway or which is located more than eight feet from the edge of pavement.

5. On Tangents, mount delineators every 62.5-feet or every 10^{th} post.

6. On Curves, mount delineators every 31.25-feet or every 5^{th} post.

Exceptions and/or modifications will only be made with the approval of the Resident.

Contractor is required to submit installation method for review and approval to the Resident.

606.02 Materials

The fourth paragraph is deleted and replaced with the following:

The reflectorized beam guardrail delineators shall be fabricated from galvanized steel.

Reflective sheeting shall meet the requirements of Subsection 719.01, Reflective Sheeting – minimum ASTM Type XI; 3M™ Diamond Grade™ DG³ Reflective Sheeting Series 4000 or approved equal.

606.08 Method of Measurement

The following paragraph is added:

Reflectorized Beam Guardrail Delineators will be measured by each unit of the kind specified and installed. Maintenance and replacement of delineators will not be measured separately for payment unless otherwise approved by the Resident.

606.09 Basis of Payment

The second and third sentences in the first paragraph are deleted and replaced with the following:

Reflectorized Beam Guardrail Delineators will be paid for at the Contract unit price each when installed on existing guardrail, complete in place, which price shall be full payment for furnishing and installing all components and for all incidentals necessary to complete the installation. Reflectorized Beam Guardrail Delineators will not be paid for on new guardrail.

Payment will be made under:

Pay Item		Pay Unit
606.352	Reflectorized Beam Guardrail Delineator	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Delineator Post – Remove and Reset)
(Delineator Post - Remove and Stack)

606.01 Description

The following paragraphs are added:

This work shall also consist of furnishing and installing new delineator posts and/or removing and resetting and/or removing and stacking existing delineator posts within the Contract limits at the Crosby Maintenance Facility at Mile Marker 45.8 Southbound. The existing reflectorized delineator panels shall be removed and replaced with new reflectorized delineator panels as required by the Resident.

Existing and new delineator posts shall be located as follows, with the indicated panel:

Outside Shoulder:

- One at guardrail trailing ends (green delineator).
- Two at guardrail approach ends (one red delineator on first post and one red delineator on angle points.)

Median:

- One at guardrail trailing ends (green delineator, facing traffic).
- Two at guardrail approach ends (one red delineator on first post of CAT units, green on guard rail side, red on median opening side; and one red (both sides) delineator at angle point.)
- One at all other median guardrail angle points (red on both sides)

Other Locations:

- One at culvert outlets (green delineator).
- Twenty per mile evenly spaced at the edge of outside shoulder (white delineator).
- One at electrical junction boxes not associated with another item (red delineator).
- One at communication only junction boxes not associated with another item (orange delineator).

Delineator posts that do not exist in the locations described above, shall be supplied and installed by the Contractor. The installation of the delineator post shall include the demountable reflectorized delineator panel.

White edge delineators shall not be installed on any portion of the widened shoulder for Guardrail 350 Flared Terminal installations, and shall not be installed behind the Guardrail 350 Flared Terminal rail segments.

606.02 Materials

The following paragraphs are added:

Non-guardrail Delineator Posts shall conform to Subsection 606.02 paragraph 3.

The seventh through ninth sentences of the fourth paragraph are deleted and replaced with the following:

Reflectorized flexible guardrail markers shall be a minimum of 2-inches in diameter, a maximum of 36" in length, ovalized at the top of the post to allow application of 3 inch by 9 inch high intensity reflective sheeting, and shall be capable of recovering from repeated impacts. The flexible guardrail delineator markers shall be grey and capped at the top with a flexible rubber cap; Safe-Hit Flexible Guardrail Delineator or approved equal. Reflective material shall meet the requirements of ASTM Type IX Diamond Grade VIP (Visual Impact Performance).

The demountable reflectorized delineator panels shall meet the material requirements of Subsection 719.06. The delineator panel shall be rectangles measuring 9" x 3".

606.03 Posts

The following paragraphs are added:

The top of delineator posts shall be installed 4' - 6" (54")) above edge of pavement elevation. Delineators shall be installed four feet from edge of pavement except those delineating end treatments, culverts and electrical items.

Mile marker posts shall be mounted on breakaway supports. The bottom of the sign shall be 5' - 0" (60") above the pavement at the solid white line and shall be offset five feet from the edge of pavement.

A mock-up of the guardrail delineator posts shall be submitted to the Resident for approval prior to installation.

Any materials damaged by the Contractor's operations shall be replaced at no additional cost to the Authority.

Top of the delineator panel shall be flush with the top of post.

606.08 Method of Measurement

The following paragraphs are added:

Delineator Posts shall be measured by each unit satisfactorily installed. Delineator Post-Removed and Reset will be measured by each unit satisfactorily removed and reset. Delineator Posts Removed and Stacked will be measured by each unit satisfactorily removed and stacked.

Mile Marker post shall be measured for payment as Delineator Post. The breakaway supports shall be incidental to the Underdrain Delineator Post pay item.

606.09 Basis of Payment

The following sentences are added:

The accepted quantity of Delineator Posts will be paid for under the Underdrain Delineator Post item, at the Contract unit price per each which price shall be full compensation for the post and specified delineator or mile marker panel, complete in place.

The accepted quantity of Delineator Post - Removed and Reset will be paid for at the Contract unit price each, which price shall be full compensation for removing and resetting the delineator panel or mile marker panel and post and all incidentals necessary to complete the work.

The accepted quantity of Delineator Posts Removed and Stacked will be paid for at the Contract unit price each, which price shall be full compensation for removing and stacking delineator panel or mile marker panel and posts and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
606.3561	Delineator Post - Remove and Reset	Each
606.3562	Delineator Post - Remove and Stack	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Guardrail – Remove and Reset)
(Guardrail – Remove, Modify and Reset, Single Rail)
(Guardrail – Remove, Modify and Reset, Double Rail)
(Guardrail - Remove and Stack)
(Guardrail Adjust – Single Rail)
(Guardrail Adjust – Double Rail)

606.01 Description

The following paragraphs are added:

This work shall also consist of adjusting the height of the existing single and double rail guardrail in locations where the existing height of rail is not 30 inches. The guardrail shall be adjusted to a height of 30 inches. Existing single and double rail shall also be adjusted for lean.

The guardrail adjustment shall take place at all necessary locations; approximate locations are listed in the schedule of guardrail limits both median and outside shoulder. Exact locations for adjustment shall be determined by the Resident. If, during the course of the work, the contractor finds additional rail to be adjusted, then he shall notify the Resident, and the Resident determine if the rail is to be adjusted.

This work shall also consist of removing, stockpiling and stacking of existing single and double guardrail elements, component parts and hardware suitable for replacement as approved by the Resident. At the completion of the Contract, any unused guardrail elements, posts, component parts and hardware suitable for reuse shall remain the property of the Authority. Any guardrail elements, posts, component parts and hardware unsuitable for reuse shall become property of the Contractor.

Stockpiled materials, suitable for reuse, shall be utilized on Remove, Modify and Reset items prior to new materials being paid for.

This work shall consist of removing, disposing of existing guardrail elements, component parts and hardware, as directed by the Resident. All materials shall become the property of the Contractor and shall be removed from the site at the completion of the Project. The Contractor shall provide the Resident with an affidavit stating the final location of all disposed material and that the material was disposed of in accordance with the Maine Department of Environmental Protection Solid Waste Regulations.

606.02 Materials

The following paragraph is added at the end of the subsection:

New non-wood offset blocks conforming to NCHRP 350 Test Level 3 shall be installed on all guardrail being reset. The existing steel offset brackets and backup plates shall become the property of the contractor.

The following Subsection is added:

606.021 General

All existing guardrail to be raised or lowered shall be completed prior to new guardrail or end treatments being attached.

606.036 Adjusting Existing Guardrail

Any materials or galvanizing damaged by the Contractor's operations shall be replaced or touched-up at no additional cost to the Authority.

Guardrail posts shall be raised to a minimum of five inches above final elevation prior to driving post to final elevation; this applies to both raising and lowering rail.

Any given length of guardrail to be adjusted shall be done in such a way that top of rail elevations do not vary drastically between each section of guardrail. Rail height tolerance shall be 30 inches, plus 0 inches, minus 1/2 inch. The 30 inches shall be measured from the edge of pavement to the top of rail beam when within 2 feet of the edge of pavement.

Rail shall be adjusted for lean where needed. All posts shall be plumb after adjusting for lean.

When the rail tapers from one bound to the other the rail shall be adjusted to the correct height on the farthest ends and shall be adjusted towards the center of the median to create a smooth line.

Earth around each adjusted or reset post shall be raked and compacted with a minimum 8 pound hand tamper or an approved device. Holes created due to adjusting or resetting a post shall be filled with a similar surrounding material and compacted.

606.08 Method of Measurement

The following paragraphs are added:

Adjusting of both single and double rail guardrail shall be measured by the linear foot of Guardrail adjusted and accepted.

Raking and compacting the earth around each reset post with a minimum 8 pound hand tamper or an approved device, and infilling and compacting holes created due to resetting posts with

a similar surrounding material will not be paid separately, but shall be incidental to the Guardrail - Remove, Modify and Reset Pay or Guardrail - Adjust pay items.

Guardrail Remove and Stack will be measured on a linear foot basis of guardrail satisfactorily removed and stockpiled whether single rail or double rail. Single and double twisted end sections will be measured for payment on a linear foot basis as 25 feet of guardrail removed.

Guardrail removed and not reset or stacked shall be incidental to Contract Items and include all removal, disposal, equipment and labor necessary to satisfactorily complete the work.

Steel posts to replace damaged posts shall come from the stockpile of guardrail components to be disposed of, from this Contract and will not be measured separately for payment. If, in the opinion of the Resident, there are no suitable steel posts in the stockpile then steel posts will be measured for payment.

W-beam rail elements to replace damaged rail elements shall come from the stockpile of guardrail from the Remove and Stack or the guardrail to be disposed of from this Contract and will not be measured separately for payment. If, in the opinion of the Resident, there are no suitable W-beam rail elements in the stockpile then the W-beam rail elements will be measured for payment.

606.09 Basis of Payment

The following paragraphs are added:

Adjusting of single and double rail guardrail will be paid for at the Contract unit price per linear foot and shall be full compensation for furnishing all labor, equipment and materials necessary to complete the work. Guardrail Adjust will not be measured for payment until all compaction has been completed.

The accepted quantity of guardrail removal will be paid for at the Contract unit price bid, which price shall be full compensation for removing, transporting and stacking all guardrail elements, component parts and hardware, equipment, labor and all incidentals necessary to complete the work. No additional payment will be made for double rail.

Payment will be made under:

Pay Item		Pay Unit
606.36	Guardrail – Remove and Reset	Linear Foot
606.3605	Guardrail – Remove, Modify, and Reset Single Rail	Linear Foot
606.3606	Guardrail – Remove, Modify, and Reset Double Rail	Linear Foot
606.369	Guardrail - Remove and Stack	Linear Foot
606.3621	Guardrail Adjust, Single Rail	Linear Foot
606.3622	Guardrail Adjust, Double Rail	Linear Foot

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Single Offset Block – W-Beam)
(Single Offset Block – Thrie-Beam)
(Asymmetrical Thrie Beam Transition)

606.01 Description

The following paragraph is added:

This work shall consist of furnishing and installing single offset blocks at all existing guardrail beam locations that are not part of a new or remove, modify and reset location and as shown on the Contract Documents. New NCHRP 350 compliant offset block shall be installed on existing galvanized steel posts and connected to Guardrail Type 3d and Thrie Beam Rail.

This work shall consist of removing and stacking existing Thrie Beam Transition panels, furnishing and installing the Asymmetrical Thrie beam to W-beam Transition panels, single rail - modified section and double rail modified section, connecting it to the existing or proposed W-Beam guardrail and Thrie Beam modified at locations on the Maine Turnpike, as shown on the Plans or as approved by the Resident. All guardrail components shall have passed the NCHRP 350 Test Level
3. Composite offset blocks shall be used.

606.02 Materials

The following sentences are added:

Offset blocks shall have passed NCHRP 350 Test Level 3 and shall not be wood. The following Subsection is added:

606.021 General

The existing median guardrail posts have four off-center bolt holes used to attach the existing steel offset blocks. The new offset blocks have two bolt holes centered on the W-beam section. The existing posts must be retrofitted to receive the new non-wood offset block assembly. Additional bolt holes required in the existing posts shall be drilled or punched but the size shall not exceed the dimension given by the manufacturer. Metal around the holes shall be cleaned and painted with a cold-applied zinc-rich paint. The holes shall not be burned with a torch.

The completed guardrail system shall be in conformance with the NCHRP 350 Test Level 3 requirements.

606.08 Method of Measurement

The following paragraphs are added:

Single Offset Block - W-Beam and Single Offset Block - Thrie Beam shall be measured per each unit installed and accepted.

Asymmetrical Thrie Beam Transition shall be measured by each unit installed and accepted.

606.09 Basis of Payment

The following paragraphs are added:

New Single Offset Block - W-Beam and Single Offset Block - Thrie Beam furnished and installed at specified locations will be paid for at the Contract unit price each complete in place and accepted. Payment shall be full compensation for furnishing all labor, equipment and materials necessary to complete the work including, but not necessarily limited to, removal of existing rail beam, removal and disposal of existing offset block, drilling new holes in existing post, application of galvanized paint, furnishing and installing new non-wood offset block, removal and disposal of back-up plates, and resetting the rail beam.

Asymmetrical Thrie Beam Transition will be paid for at the Contract unit price each complete in place, and shall be full compensation for furnishing all labor, equipment and materials necessary to complete the work consisting of, but not necessarily limited to, furnishing and installing the Asymmetrical Thrie Beam to Existing W-beam Transition, Single Rail - Modified Section and Existing Double Rail – Modified Section, and all detailed accessories; furnishing and installing all required posts, composite offset blocks, cables, nuts, bolts, washers, and all other items necessary to complete the installation and connection to the existing or proposed W-Beam and the Thrie Beam – Modified.

Payment will be made under:

Pay Item		Pay Unit
606.471	Single Offset Block – W-Beam	Each
606.472	Single Offset Block – Thrie Beam	Each
606.701	Asymmetrical Thrie Beam Transition	Each

SPECIAL PROVISION

SECTION 606

GUARDRAIL

(Guardrail – Remove and Stack Existing Crash End)
(Guardrail – Remove and Reset Existing Crash End)

606.01 Description

The following paragraph is added:

This work shall consist of removing and stacking existing crash ends (MELT units, 350, MASH), component parts and hardware, and removing, modifying and resetting existing crash ends at locations shown on the plans.

This work consists of removing and resetting existing Crash End System as shown on the plans, backfilling post holes, and repairing pavements as required.

606.035 Construction Requirements

Existing post holes shall be backfilled with compacted gravel and finished with 3-inches of asphalt grindings. Post holes located in paved sections shall be backfilled with Hot Bituminous Pavement to a thickness matching the surrounding pavement thickness.

Any parts and/or components of existing Crash End that are found to be deficient, damaged, or otherwise in unsatisfactory condition prior to removal shall be replaced by the contractor with parts and components furnished by the Authority.

Any parts and/or components of existing Crash End that are damaged by the contractor during removal and resetting of the units shall be replaced with new parts and/or components at no cost to the Authority.

606.08 Method of Measurement

The following paragraph is added:

Guardrail Remove and Stack Existing Crash End will be measured on a per each basis of crash end satisfactorily removed and stacked.

Guardrail Remove and Reset Existing Crash End will be measured on a per each basis of crash end satisfactorily removed and reset.

606.09 Basis of Payment

The following paragraphs are added:

The accepted quantity of Guardrail Remove and Stack Existing Crash End will be paid for at the Contract unit price bid, which price shall be full compensation for removing, transporting and disposing all guardrail elements, component parts and hardware, backfilling post holes, equipment, labor and all incidentals necessary to complete the work.

Guardrail – Remove and Reset Existing Crash End will be paid for at the Contract unit price, complete in place and accepted. Payment shall be full compensation for furnishing all labor, equipment, materials and incidentals necessary to complete the work.

Connection of Crash End Systems to the existing median guardrail will not be paid for separately, but shall be incidental to Item 606.83.

Payment will be made under:

Pay Item		Pay Unit
606.82	Guardrail - Remove and Stack Existing Crash End	Each
606.83	Guardrail - Remove and Reset Existing Crash End	Each

SPECIAL PROVISION

SECTION 607

FENCES

(Stockade Fence – 6’ Tall)

607.01 Description

The following paragraph is added:

This work shall consist of constructing wood stockade fencing.

606.02 Materials

The following sentences are added:

Cedar Posts 710.06

Stockade fence shall be a 6’ tall premium grade solid White Maine Cedar stockade fencing with rails and round posts. Fencing shall be provided in 8’ typical sections. Fencing shall include custom built sections if required due to site conditions.

Stockade fencing shall be equivalent to Premium Maine White Cedar Fence as manufactured by Mainline Fence, Gorham, Maine

607.07 Basis of Payment

Payment will be made under:

Pay Item		Pay Unit
607.45	Stockade Fence – 6’ Tall	Linear Foot

SPECIAL PROVISION

SECTION 609

CURB

(Concrete Slipform Curb)
(Concrete Slipform Curb – Terminal End)

609.01 Description

This work shall consist of furnishing and placing Slipform Concrete Curb in close conformity with the plans, or as authorized by the Resident.

609.02 Materials

Except as provided below, the materials used shall meet the requirements specified in Section 700 – Materials:

Portland Cement and Portland Pozzolan Cement	701.01
Water	701.02
Fine Aggregate for Concrete	703.01
Coarse Aggregate for Concrete	703.02
Air Entraining Admixtures	703.03

The aggregate shall conform to the requirements of Subsections 703.01 and 703.02.

A mix design for the Portland Cement Concrete shall be submitted to the Resident meeting the requirements of Class A or Class AAA.

Entrained air content of Slipform curbing shall be 4.0% to 7.0%.

Partially discharged loads may be retempered with water provided the maximum water to cement ratio is not exceeded.

Maximum concrete temperature at placement shall be 90°F.

Proposed mix designs may contain polypropylene fibers.

609.03 General

A. Preparation of Base. Before placing the curb, the foundation course shall be thoroughly cleaned of all foreign and objectionable material. The Contractor shall not place Slipform Concrete Curb on a wet or frozen base. Base pavement for placing epoxy resin binder and slipform curbing may be in SSD condition but no standing water shall be allowed. String or chalk lines shall be positioned on the prepared base to provide guide lines. For HMA or PCC base the foundation shall be uniformly painted with an epoxy resin adhesive that meets AASHTO M 235, Type I, II, III, IV, or V. Proposed Epoxy Resin Adhesive from the

Departments QPL shall be submitted with the concrete mix design for approval prior to placement and used in accordance with manufacturer's recommendations.

B. Placing. Concrete shall be placed with an approved Slipform machine that will produce a finished product according to the design specified in the plans. For cold weather Slipforming, the outside temperature must be at least 36°F (2.2°C) and rising. The curb shall be placed on a firm, uniform bearing surface, shall conform to the section profile specified in the plans, and shall match the appropriate grade. Expansion joints will be provided at ends of curve radii, or wherever the curb meets rigid structures such as building foundations or fire hydrants. Contraction joints will be placed at 10 foot (3 m) intervals using sawing methods, which shall cut 1-3" into the concrete. Joints shall be constructed perpendicular to the subgrade and match other joints in the roadways, sidewalks, or other structures when applicable.

C. Curing and Sealing. Proper curing shall be insured through the use of either a combination curing/sealing compound spray that meets ASTM 1315 Type 1 – Class A, or a curing compound spray that meets ASTM 309 Type 1-D – Class A. Curing may also be accomplished by the methods specified in Section 502.15 of the Specifications.

   If a combination curing/sealing compound spray is not used, a separate sealing compound from the MaineDOT Qualified Products List for a Type 2 sealer shall be applied after the concrete has cured.

D. Protection. Slipform curb must be adequately protected after placement. The concrete shall be allowed to cure for at least 72 hours. During cold weather conditions, when temperatures drop below the required temperature of 36°F (2.2°C) after placement, curbing shall be protected by concrete blankets or a combination of plastic sheeting and straw. After any placement of Slipform curb, regardless of weather conditions, the placed curb shall be adequately protected by traffic control devices as necessary.

E. Marking. When required, the curb shall be painted and coated with glass beads in accordance with Section 627 – Pavement Marking. Curb designated to be painted shall not be sealed unless a combination curing/sealing compound is used.

F. Acceptance. Curb shall be accepted or rejected based on finish, alignment, entrained air content, and compressive strength. Acceptance testing for air content and compressive strength will be under 502. All damaged curb shall be removed and replaced at the Contractor's expense.

609.04 Method of Measurement

Concrete Slipform Curb and Concrete Slipform Curb – Terminal End will be measured by the linear foot along the front face of the curb at the elevation of the finished pavement, complete in place and accepted.

607.05 Basis of Payment

The accepted quantities of Concrete Slipform Curb and Concrete Slipform Curb – Terminal End will be paid for at the contract unit price per linear foot as specified.

There will be no separate payment for concrete, sealing, incidental materials, or labor needed to install the curb, but these will be considered included in the work of the related curb.

Removal of existing curb and necessary excavation for installing curb will not be paid for directly, but shall be considered to be included in the curb pay item. Base and Subbase material will be paid for under Section 304 – Aggregate Base and Subbase Course. Backing up machine laid curb is incidental to the curb items. Loam, as directed, will be paid under 615 – Loam.

Payment will be made under:

Pay Item		Pay Unit
609.21	Concrete Slipform Curb	Linear Foot
609.219	Concrete Slipform Curb – Terminal End	Linear Foot

SPECIAL PROVISION

SECTION 609

CURB

(Terminal Curb Type 1)
(Terminal Curb Type 1 – Circular)

609.09 Method of Measurement

The first paragraph is deleted and replaced with the following:

Curb, both new and reset, and terminal curb will be measured by the linear foot along the front face of the curb at the elevation of the finished pavement, complete in place and accepted. Curb inlets at catch basins, including doweling, will not be measured for payment. Reset transition sections and terminal curb will be included in the measurement for resetting curb.

609.10 Basis of Payment

Basis of Payment is amended with the addition of the following:

Pay Item		Pay Unit
609.221	Terminal Curb Type 1	Linear Foot
609.222	Terminal Curb Type 1 – Circular	Linear Foot

SPECIAL PROVISION

SECTION 610

STONE FILL, RIPRAP, STONE BLANKET AND STONE DITCH PROTECTION

(Temporary Stone Check Dams)

610.01 Description

Paragraph (g) is added as follows:

(g) Stone Check Dams – Machine placed stone, including the placement, removal and storage of the stone used for temporary stone check dams.

610.032.e. Stone Check Dams

The following paragraph is added:

Stone check dams shall be constructed in accordance with the details as shown on the Plans, detailed in the MaineDOT's latest Best Management Practices, or as approved by the Resident. The stone shall be placed in one operation without special handling or handwork except to create a low point along the top gradient above the ditch flow lines.

The following Subsection is added:

610.033 Removing Stone

The stone for temporary stone check dams shall be removed after vegetation has been established in the ditches as approved by the Resident.

Any damage to the slopes and ditches caused by the removal of the stone check dams shall be repaired by the Contractor at his own expense.

The area directly under the temporary stone check dams shall be loamed, seeded and mulched immediately after the removal of the stone check dams. The loam, seed and mulch will be measured for payment under the appropriate pay items.

Stone used for temporary stone check dams shall be removed and stored and shall become the property of the Contractor at the completion of the Project.

The following Subsection is added:

610.034 Maintenance

Stone check dams shall be maintained by the Contractor. Sediment deposits behind check dams shall be removed when the depth of sediment reaches 50 percent of the check dam height.

610.05 Method of Measurement

The following paragraphs are added:

Stone for Temporary Stone Check Dams will be measured by the cubic yard complete in place. The removal and storage of the stone will not be measured separately for payment, but shall be included in the Temporary Stone Check Dam item. This shall include the transporting and unloading of the stone. If this stone is reused on the Project, it will be measured separately for payment under the appropriate pay item.

610.06 Basis of Payment

The following sentences are added:

The accepted quantities of stone for Temporary Stone Check Dams will be paid for at the Contract unit price per cubic yard. The removal and disposal of sediment from behind the Temporary Stone Check Dams will not be paid separately, but shall be incidental to the Temporary Stone Check Dam pay item.

Payment will be made under:

Pay Item		Pay Unit
610.181	Temporary Stone Check Dam	Cubic Yard

SPECIAL PROVISION

SECTION 610

STONE FILL, RIPRAP, STONE BLANKET, AND STONE DITCH PROTECTION

(Void-Filled Riprap)

610.01 Description

This work consists of excavating for and constructing a protective covering of stone, with the voids filled by granular material.

610.02 Materials

Material for Void-Filled Riprap - Type A shall conform to the following requirements:

a. Approximately 3 parts by volume shall be Plain Riprap meeting the requirements of Standard Specifications Subsection 703.26.
b. Approximately 1 part by volume shall be Streambed Material meeting the requirements of Special Provision Section 203, Special Fill - Streambed Material.

The proportion of the Plain Riprap to Streambed Material may be modified by the Resident if it is apparent that insufficient gravel is included to fill all the voids or excess gravel is reducing the stability of the riprap. The Contractor shall premix the Plain Riprap and Streambed Gravel prior to placement.

Material for Void-Filled Riprap - Type B shall conform to the following requirements:

a. Approximately 3 parts by volume shall be Plain Riprap meeting the requirement of Standard Specification Subsection 703.26
b. Approximately 1 part by volume shall be stockpiled clean Native Material or Loam meeting the requirement of Standard Specification 615.07.

The proportion of the Plain Riprap to Native Material/Loam may be modified by the Resident if it is apparent that insufficient material is included to fill all the voids or excess material is reducing the stability of the riprap. The Contractor shall premix the Plain Riprap and Native Material/Loam prior to placement.

The Contractor shall identify the source and proposed mixes for inspection at least 10 working days prior to the start of stream channel construction. The grading of the stone portion of Void-Filled Riprap shall be determined by the Resident by visual inspection in accordance with the Standard Specifications Subsection 610.032d Inspection.

610.03 Construction Requirements

Void-Filled Riprap - Type A construction shall be placed full depth in one operation, approximately true to the required slope line and grade of the channel and be uniform in appearance.

Prior to returning stream flow to the channel, the riprap shall be flooded to the maximum extent practical to compact the gravel material. Voids shall be filled by adding additional Streambed Gravel as filler material and flooding to wash the material in. If the top layer of material in the channel is too coarse to pond water on top, Common Borrow, Granular Borrow for Embankment, excavation, dredge, or other material with a significant proportion of fines and approved by the Resident shall be washed into the Void-Filled Riprap until the voids are filled and sealed so that water ponds on the surface.

Void-Filled Riprap - Type B shall be placed full depth in one operation along the riverbanks as shown on the plans. Additional Native Material/Topsoil shall be used to fill voids on the surface of the Void-Filled Riprap.

610.04 Method of Measure

Void-Filled Riprap – Type A or B will be measured by the cubic yard, complete in place.

610.05 Basis of Payment

Payment for Void Filled Riprap – Type A or B will be made at the contract unit price per cubic yard complete in place.

Costs of all required excavation below the slope line for the placement of bedding, riprap, and gravel fill material with significant proportion of fines and for furnishing and placing the bedding material itself will be considered incidental to the contract item and no separate payment will be made. Water and filler material added to the Void Filled Riprap to fill voids shall be considered incidental to the contract item and no separate payment will be made.

Payment will be made under:

Pay Item		Pay Unit
610.213	Void-Filled Riprap – Type A or B	Cubic Yard

SPECIAL PROVISION

SECTION 613

EROSION CONTROL BLANKET

613.01 Description

This work shall also include seeding, mulching and watering the median swale and/or longitudinal flow line to the limits and width as shown on the Plans or as directed by the Resident.

613.02 Materials

The following sentences are added:

Seeding shall meet the requirements of Section 618, Seeding, Method Number 2.

Mulch shall meet the requirements of Section 619.

The following Subsection is added:

613.041 Maintenance and Acceptance

See Section 618.10 for maintenance and acceptance of seeding.

613.042 Mulch

All mulch shall be placed after the area has been seeded and prior to the installation of the Erosion Control Blanket.

613.09 Basis of Payment

The following "and mulch" is added after the words "initial seeding" in the second sentence.

SPECIAL PROVISIONS

SECTION 618

SEEDING

(Special Seeding)

618.02 Materials

The following paragraph is added:

Special Seed (wetland seed mix-moist) for Goosefare Brook flood plain shall be "New England Erosion Control/Restoration Mix for the Detention basins and Moist Sites" as supplied by New England Wetland Plants, Inc., Amherst, MA or an approved equal. Wetland seed mix must be approved by the MTA Wetland Scientist before application. All fertilizers, soil conditioners, limestone and other materials required to germinate, initiate and sustain seed growth shall be materials recommended by New England Wetland Plants, Inc. or other approved seed manufacturer as determined by the Resident.

618.03 Rate of Application

Subsection (a) is deleted in its entirety and replaced with the following:

(a) Except for Special Seed mix, agricultural ground limestone shall be applied at the rate of 33 pounds per unit for all seeding methods. Liquid lime shall be applied at the rate of 1/2 pint per unit for hydraulic method. A 1/2 pint of liquid lime shall be mixed with five pints of water.

Subsection (g) is added:

g. The Special Seeding shall be applied at a rate of 1 Unit per 1,000 SF. Fertilizers, limestone and other soil conditioners shall be applied at the manufacturers recommended rate. The wetland seed shall be placed on a four-inch layer of loam and lightly raked into that material. All seed shall be covered by a temporary erosion Control blanket immediately after seeding.

618.10 Maintenance and Acceptance

The second paragraph is deleted and replaced with the following:

The Contractor shall water the special seed as necessary and shall insure the continued growth of the special seed. The Authority will accept areas sown with Special Seed upon attainment of a reasonably thick stand of grass with at least 90 percent coverage, free from sizable thin or bare spots. Areas not meeting this requirement shall be reseeded and shall comply with Subsections 618.03 through 618.09.

618.12 Basis of Payment

The following paragraph is added:

The Authority will pay for the accepted quantity of Special Seed at the Contract price per unit, which price shall be full compensation for furnishing and spreading seed, limestone fertilizer, and inoculants. The price shall also include any reseeding, watering, and maintenance necessary to meet the requirements of Section 618.10, Maintenance and Acceptance.

Payment will be made under:

Pay Item		Pay Unit
618.143	Special Seeding	Unit

SPECIAL PROVISION

SECTION 619

MULCH

(Mulch – Plan Quantity)
(Temporary Mulch)

619.01 Description

The first paragraph is modified by the addition of the following:

"as a temporary or permanent erosion control measure" after the word "mulch."

Add the following sentence at the end of the first paragraph:

Refer to Section 656 Temporary Soil and Water Pollution Control, for more information on Temporary Mulch.

619.03 General

The first paragraph is deleted and replaced with the following:

Cellulose fiber mulch shall not be used within 200 feet of a wetland or stream. The limits shall be 200 feet up station and down station of the wetland or streams as well as the slopes adjacent to the stream. The application of hay or straw mulch with an approved binder shall be used at these locations to prevent erosion.

The use of cellulose fiber mulch will only be allowed at other areas with the approval of the Resident. The Contractor may be required to demonstrate that the material may be applied in a manner that will prevent erosion and will aid in the establishment of permanent vegetation. The Resident reserves the right to require the use of hay or straw mulch at all locations if he determines that the cellulose mulch is ineffective. Cellulose fiber mulch is not acceptable for winter stabilization.

619.06 Method of Measurement

The following sentence is added:

Temporary Mulch will be paid for by the lump sum.

619.07 Basis of Payment

Temporary Mulch will be paid for at the Contract price per lump sum which shall be full compensation for furnishing and spreading the Temporary Mulch as many times as necessary as determined by the Contractor's operations and staging. The price shall also include the additional mulch netting and snow removal necessary during the winter months.

Payment will be made under:

Pay Item		Pay Unit
619.1201	Mulch – Plan Quantity	Unit
619.1202	Temporary Mulch	Lump Sum

SPECIAL PROVISION

SECTION 620

DRAINAGE GEOTEXTILE

(Impervious Liner)

620.01 Description

The following paragraphs are added:

This work shall consist of installing an impervious liner in between two layers of drainage geotextiles at each of the underdrained soil filters shown on the plans.

620.02 Materials

The following sentences are added:

The Impervious Liner shall consist of linear low density polyethylene (LLDPE), or PVC with a minimum thickness of 30 millimeters.

620.03 Placement

The following paragraphs are added:

The Impervious Liner shall be installed on the sides and bottom of the underdrained soil filter and extend up the slope to an elevation greater than the top of embankment or into subgrade. Install drainage geotextile on both sides of the impervious liner to protect the liner from puncture and in accordance with the manufacturer's recommendations. Refer to the Underdrained Soil Filter Detail included in the plan set as Drainage Details 1 of 3, for more information.

620.09 Method of Measurement

The following sentence is added:

Impervious Liner will be measured by the number of square yards of surface area covered and in direct contact with the cover material.

620.10 Basis of Payment

The following sentence is added:

Impervious Liner will be paid for at the contract unit price per square yard. Such payment shall be full compensation for furnishing and placing, for all required surface preparation, for all labor, tools, materials and equipment needed, for repairing torn or damaged liner, for all temporary hold downs, and all other incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
620.561	Impervious Liner	Square Yard

SPECIAL PROVISION

SECTION 621

LANDSCAPING

(Tree and Shrub Planting)

621.01 Description

The following sentence is added:

Pursuant to Section 104.5.9, a two-year Maintenance Bond will be required in lieu of a Performance Bond by the Contractor or the landscape subcontractor for all 621 items. The Bond must name the "Maine Turnpike Authority" as an oblige. The Contractor shall provide a copy of said bond to the Authority before the performance of any affected on-site Work. Should the subcontractor be required to provide the Maintenance Bond, the Contractor hereby authorizes the Authority to directly contact landscape subcontractor and/or its Surety in the event of a failure of the bonded item to replace the specified items. There will be no specific establishment period in the Contract, but shall be considered incidental to the Contract.

621.02 Materials - General

The following sentence is added:

Submittals: The Contractor shall provide samples and data sheets for fertilizers for approval by the Resident. The Contractor shall also submit for approval the final plant list for Goosefare Brook flood plain to be reviewed and approved by the MTA wetland scientist for acceptance to confirm conformance with permit conditions.

621.18 Layout

The following paragraph is added:

The Resident shall be on-site during placement of all plants to identify location of plantings prior to any excavating any tree/shrub pits and plantings.

621.20 Planting Seasons

The following paragraph is added:

Installation of the specified plants in Goosefare Brook flood plain shall be performed only during periods when beneficial results can be obtained, based on seasonal and climatic factors and local weather conditions. Planting of shrubs shall occur before June 1st (preferably) or June 15th to allow time during the growing season for root systems to become well established prior to winter. This specification is intended to help plants withstand the expected potential for stress and damage caused by road salt applications in this location.

621.23 Setting Plants

The following paragraphs are added:

Stream Buffer plantings shall be installed on either slopes, shallow mounds, or shallow berms to shed runoff and help minimize the accumulation of salt at the base of plants. Plants shall not be installed in depressions.

The Resident will reject any plants not installed correctly and the Contractor shall re-install plant stock as determined by the Resident at no additional cost to the Authority.

List of Plantings at Goosefare Brook

ITEM NO.	DESCRIPTIONS	UNIT	QUANTITY
621.264	Multi-stem Deciduous Tree Group A		
	Gray Birch 8 – 10 Feet Multi-Stem	EA	2
621.273	Large Deciduous Tree (2”-2.5” Caliper) Group A		
	Red Maple 2 – 2.5 Inch Caliper	EA	4
	Balsam Fir 2 – 2.5 Inch Caliper	EA	3
	Black Willow 8 – 10 Feet	EA	2
621.552	Deciduous Shrubs (3 – 4 Feet) Group A		
	Nannyberry 3 – 4 Feet	EA	15
	Winterberry 3 – 4 Feet	EA	12
	Serviceberry 3 – 4 Feet Multi-Stem	EA	8

List of Plantings at Administration Building - Southbound

ITEM NO.	DESCRIPTIONS	UNIT	QUANTITY
621.389	Evergreens (15”-18”) Group A		
	Sargent Juniper 15 – 18 Inches	EA	4
621.401	Evergreens (2 - 2.5 Feet) Group A		
	Taunton Yew 2 – 2.5 Feet	EA	2
621.513	Hybrid Rhododendron (2.5 -3 Feet)		
	Rhododendron 2.5 – 3 Feet	EA	2
621.552	Deciduous Shrubs (3 – 4 Feet) Group A		
	Kelsey Dogwood 3 – 4 Feet	EA	4

List of Plantings at Administration Building - Northbound

ITEM NO.	DESCRIPTIONS	UNIT	QUANTITY
621.389	Evergreens (15”-18”) Group A		
	Sargent Juniper 15 – 18 Inches	EA	2
621.401	Evergreens (2 - 2.5 Feet) Group A		
	Taunton Yew 2 – 2.5 Feet	EA	2
621.513	Hybrid Rhododendron (2.5 -3 Feet)		
	Rhododendron 2.5 – 3 Feet	EA	3

List of Plantings at Southbound Plaza Entrance Road

ITEM NO.	DESCRIPTIONS	UNIT	QUANTITY
621.046	Evergreen Tree (8 – 10 Feet) Group A		
	Arborvitae 8 – 10 Feet	EA	13
621.273	Large Deciduous Tree (2”-2.5” Caliper) Group A		
	Quaking Aspen 2 – 2.5 Inch Caliper	EA	6
621.552	Deciduous Shrubs (3 – 4 Feet) Group A		
	Nannyberry 3 – 4 Feet	EA	21

621.25 Fertilizing

The following sentence is added:

Slow release fertilizer tablets or packets shall be placed within the planting hole, at least one inch below the surface, but not directly touching the root mass.

621.26 Mulching

The following sentences are added:

In order to reduce competition from herbaceous species and threats from herbivory, all trees and shrubs planted on the site will be mulched with woodwaste mulch.

Woodwaste mulch shall consist of a clean fine-textured composted mix of decomposing bark chips, sawdust, wood shavings, and small wood fragments. Woodwaste Mulch shall meet the following requirements:

a) pH - Range 5.5 - 7.0.
b) Screen size – three inch minus.
c) Containing no less than 80 percent organic content.
d) Moisture content shall be loose and friable, not dusty.
e) No clods, roots, or materials over three inches in any dimension will be allowed.
f) No stones over 1/4 inch.
g) Must be manufactured under DEP license or permit by rule, and/or officially determined by DEP to be "non-regulated" and/or specifically approved by DEP for use in wetlands or waterways.

Woodwaste mulch shall be placed to a uniform depth of at least four (4) inches around individual plants, as part of landscape planting operations, immediately upon planting woody trees and shrubs. The placement of mulch shall cover at least the extent of disturbed soil for each plant and have a diameter of at least two feet centered on the woody plant.

The following Subsection is added:

621.32 Watering

Woody plants shall be watered during installation and at least once per week for at least three weeks after planting or until plants go dormant. Watering can be skipped any week that the

site receives more than 1/2 inch of natural rainfall during the week, or if ground conditions are saturated. The Contractor may use a sprinkler system and a pump that can be left on-site for up to two years following the original planting. The Contractor may create a borrow hole in an upland area on-site to create a ready source of water. Any such borrow holes need to be restored to preconstruction conditions prior to Project completion.

621.33 Protection from Rodents

The following paragraph is added:

All trees and shrubs planted on the site will be encased in rodent guards. The rodent guards must cover the plants to a height of at least eight (8) inches above the ground surface. The guards shall not be removed and will remain on the planted stock after completing the Establishment Period

621.36 Maintenance Period

The entire section is deleted and replaced with the following

621.36 Establishment Period

The Contractor will be responsible for maintaining at least 80% shrub survival for a period of two years following installation in accordance with permit requirements. MTA wetland scientist will monitor shrub survival rates in the Goosefare Brook flood plain annually during the two years.

The acceptability of the plant material furnished and planted under this contract shall be at the end of the Establishment Period, during which the Contractor, as necessary, shall employ all possible means to preserve the plants in a healthy and vigorously growing condition and to insure their successful establishment. During this period, the Contractor shall water, cultivate and prune the plants, and do any other work necessary to maintain the plants in a healthy growing condition. This shall include seasonal spraying with approved insecticides or fungicides as may be required. The Contractor shall also be responsible for protecting the plants from rodents. All dead or rejected plants shall be promptly removed from the project and replaced by live healthy plants meeting the same specifications. If such plants are declared unacceptable during the planting season, they shall be replaced during this planting season, otherwise, they shall be replaced during the next subsequent planting season.

Such replacement plants are subject to the same requirements as the original plants and must be replaced in turn if they fail to meet the required standards. Plants designated for spring planting only, will be replaced only during the spring planting season unless otherwise directed by the Resident.

The Establishment Period shall commence after Physical Work Complete but not before the Landscape Maintenance Bond has been received by the Resident if required by Special Provision and shall extend for two years after that date unless otherwise directed. Necessary replacements shall be made so that at the end of the Establishment Period all plants shall be in a healthy, vigorous growing condition and free from sizable die-back.

Replacements will be required for plants lost, damaged, or rejected, whatever the cause. The Contractor will be considered responsible for the plants until the end of the Establishment Period.

It shall be the sole responsibility of the Contractor to replace any unsatisfactory plants on the project regardless of whether they are specifically designated by the Resident. In the case of individual doubtful plants, the Contractor may call upon the Resident to make a determination as to their acceptability, but it shall not be incumbent on the Resident to furnish the Contractor with exact lists of replacements.

The Establishment Period shall commence after Physical Work Complete but not before the Landscape Maintenance Bond has been received by the Resident and shall extend for two years after that date unless otherwise directed.

The Contractor shall be responsible for 100 percent replacement of dead woody stock for a period of two years from the date of acceptance of the plantings.

621.361 Schedule

All trees and shrubs must be installed before June 1, 2024 (preferably) or June 15, 2024. Bare root stock must be dormant and not show any new leaves at the time of planting.

621.38 Basis of Payment

The Contractor shall provide a Landscape Maintenance Bond acceptable to the Authority, to the Authority as a condition of Final Acceptance and follow MTA Supplemental Specifications Section 110.2.3.

Payment will be made under:

Pay Item		Pay Unit
621.046	Evergreen Tree (8 – 10 Feet) Group A	Each
621.264	Multi-stem Deciduous Tree Group A	Each
621.273	Large Deciduous Tree (2”-2.5” Caliper) Group A	Each
621.389	Evergreens (15”-18”) Group A	Each
621.401	Evergreens (2 - 2.5 Feet) Group A	Each
621.513	Hybrid Rhododendron (2.5 -3 Feet)	Each
621.552	Deciduous Shrubs (3 – 4 Feet) Group A	Each

SPECIAL PROVISION

SECTION 626

FOUNDATIONS, CONDUIT, AND JUNCTION BOXES FOR HIGHWAY SIGNING, LIGHTING AND SIGNALS

(Conduit and Foundations)

The provision of Section 626 of the 2014 MaineDOT Standard Specifications shall apply with the following additions and modifications:

626.02 Materials

First sentence of second paragraph shall be replaced:

All electrical equipment shall conform to NEMA or UL standards and conduit used for conductors shall conform to NEMA, UL or EIA standards and listed certification by a Nationally Recognized Testing Laboratory.

626.034 Concrete Foundations

The following paragraph shall replace the first three (3) paragraphs:

The Authority has completed an appropriate test boring program to evaluate subsurface conditions in the general vicinity of the proposed foundations. The foundation requirements are provided on the Plans. Unless another foundation type is specified on the plans, foundations shall consist of cast-in-place reinforced concrete drilled shafts. The Contractor is responsible for the final design of the above-grade components of the mast arm or dual-purpose pole structures. Design computations that are part of the Contractor's design submittal for the mast arm or dual-purpose pole structures, shall include the actual loads (bending moments, shear force, torsion, and axial load) at the top of each foundation. These actual design loads at the top of each foundation that are provided by the Contractor as part of their submittal will be used by the Engineer to check the specified size of the drilled shafts. The Contractor shall not commence foundation construction prior to receiving approved mast arm or dual-purpose pole shop drawings and calculations.

The following paragraphs shall be added after the 10th paragraph:

The above grade portion of concrete foundation surfaces shall receive an application of Type 1C penetrating silane concrete sealer from the MaineDOT Qualified Products List. The application rate and method of application shall be in accordance with manufacturer's published recommendations.

On surfaces to be treated, all voids shall be filled with mortar and the entire surface shall be dressed by dry rubbing to remove marks and blemishes to present a neat appearance. The silane application shall not be done until 14 days minimum after casting. Surfaces shall be free from laitance, oil, dirt, grease, dust, curing compound or any other deleterious material. The temperature of the concrete shall be above 40 degrees F and below 90 degrees F at the time of application or per manufacturer's published recommendations.

Any concrete foundation that is damaged during placement or does not meet design requirements will be replaced. No repairs to the foundations will be allowed.

All precast foundations in satisfactory condition as determined by the Resident shall be stacked at the MTA Crosby Maintenance Area. All cast in place foundations, and precast foundation in unsatisfactory condition shall become property of the contractor and disposed of by the Contractor off the Turnpike right-of-way.

SPECIAL PROVISION

SECTION 626

FOUNDATIONS, CONDUIT, AND JUNCTION BOXES
FOR HIGHWAY SIGNING, LIGHTING, AND SIGNALS

(Quazite Junction Box)

626.031 Conduit

The third paragraph shall be deleted and replaced with:

All junction or pull boxes shall be vehicle rated with a minimum design load of 22,000lbs and installed as shown on the plans. Junction boxes for the traffic signal and communication conduit associated with the project shall be polymer concrete as manufactured by QUAZITE® a division of Hubbell Power Systems, or an approved equal. The boxes shall be 36" x 24" and 21" deep or 48" x 36" x 30" deep as noted on the plans. The words TRAFFIC SIGNAL or COMMUNICATION shall be stamped on the cover as noted in the Plans or directed by the Resident. All existing junction boxes in useable condition shall be removed and stacked as directed by the Resident Engineer.

Junction boxes for the electrical associated with highway lighting shall be polymer concrete as manufactured by QUAZITE® a division of Hubbell Power Systems or an approved equal. The boxes shall be 18" x 11" and 18" deep or 48" x 36" x 30" deep or as noted on the Plans. New boxes shall have the word LIGHTING stamped on the cover as noted in the Plans or directed by the Resident. The boxes shall have a 22,000-lb. load rating.

The fourth paragraph shall be deleted and replaced with:

Where conduits enter exposed junction boxes, they shall be sloped to drain towards the conduit entrance holes, unless otherwise directed. All conduit ends in exposed junction boxes, in concrete foundations and cabinets shall be fitted with bell ends. Weep holes of ¼ inch diameter shall be placed in all pull boxes, junction boxes, and fuse boxes. A 3-inch PVC drain pipe with a critter guard shall be installed projecting 3" into the gravel bedding and extend until daylight at a minimum of 0.5% slope draining away from the junction box.

The following shall be added to the end of the fifth paragraph:

During the backfilling of the trench, a "buried conduit" warning tape shall be placed above the conduit. This warning tape shall be capable of being located by a cable locator and shall be labeled and colored as appropriate to the type of utility the conduit is intended for.

626.033 Polyvinylchloride Conduit Installation

The following paragraph shall be added:

Exposed conduit shall be rigidly and securely fastened with acceptable fasteners or supports, as indicated on the plans or approved. Except as otherwise authorized, fasteners or

supports shall not be placed more than 6 feet apart on center. Conduits shall generally be supported by an approved spacer at the point of support so that there is an air space between the conduit and the supporting surface. Ends of conduit terminating in any box without a threaded hub shall be provided with a metallic locknut and insulated bushings on the inside of the box.

626.04 Method of Measurement

The following sentence is added:

Quazite junction box shall be measured by each unit in place and accepted existing or new and shall include 3-inch pvc drain pipe as shown in the plans.

Precast junction box shall be measured by each unit in place and accepted existing or new plans.

626.05 Basis of Payment

The following sentence shall be added to the third paragraph:

Payment of non-metallic conduit shall also include furnishing, installation, routing, termination, splices and connection of the wire per the plans and specifications.

The words, “polymer concrete” shall be added after the words, “precast concrete” in the second sentence of the second paragraph.

Payment will be made under:

Pay Item		Pay Unit
626.121	Quazite Junction Box (36X24)	Each
626.122	Quazite Junction Box (18X11)	Each
626.123	Quazite Junction Box (48X36)	Each

SPECIAL PROVISION

SECTION 626

FOUNDATIONS, CONDUIT, AND JUNCTION BOXES
FOR HIGHWAY SIGNING, LIGHTING AND SIGNALS

(4' X 6' Splice Box with Access Door)

626.02 General

The following paragraph is added:

4' X 6' Splice Box with Access Door for electricity shall be a two-piece precast concrete unit of dimensions depicted within the drawings. Concrete shall have a minimum compressive strength of 5,000 psi at 28-days and rated for H-20 loading.

Manhole frame and cover shall be rated for H-20 loading and as shown on the details.

626.04 Method of Measurement

The following sentence is added:

4' X 6' Splice Box with Access Door shall be measured by each unit complete in place and accepted. Providing and installation electrical manhole frame and cover shall be considered incidental to pay item 626.13 and no measurement will be required.

626.05 Basis of Payment

The following sentence is added:

The accepted quantity of 4' X 6' Splice Box with Access Door will be paid for at the Contract Unit Price per each. Payment shall include furnishing and installing the precast concrete unit, manhole frame and cover and all materials and labor needed to complete the work. Excavating and backfilling for manholes will be considered incidental to the pay item. Rock excavation, if required for installation will be paid under item 206.07 Structural Rock Excavation- Drainage and Minor Structures.

Payment will be made under:

Pay Item		Pay Unit
626.13	4' X 6' Splice Box with Access Door	Each

SPECIAL PROVISION

SECTION 626

FOUNDATIONS, CONDUIT, AND JUNCTION BOXES
FOR HIGHWAY SIGNING, LIGHTING AND SIGNALS

(Horizontal Directional Drilled Conduit)

626.01 Description

Horizontal Directional Drilling (HDD) method shall be used for installation of non-metallic conduit for highway lighting, toll systems and traffic signals when specified on the project plans or approved by the Resident. It shall include furnishing of all materials, site preparation, equipment setup, pilot bore, conduit pulling through the drilled bore, installation of pull wire and fittings, site restoration, and incidental work necessary to satisfactorily install conduit at the required locations and depths.

626.02 Materials

Conduit for Horizontal Directional Drilling shall meet requirements of Section 715.03 for non-metallic conduit. Non-metallic conduit to be installed under roadways shall be Schedule 80 or greater. Non-metallic conduit to be installed in other locations shall be Schedule 80 or greater. Conduit sections shall be joined by methods suitable for installation by HDD. Joined conduit sections must have adequate strength and flexibility to withstand the installation stresses and overburden pressures without compromising the structural stability of the conduit wall. Conduit must be able to meet the bend radius required for the proposed installation. Conduit sections shall be joined in a manner resulting in the inner surfaces being flush and even. PVC End Bells shall be utilized on all conduit ends. All conduit shall be UL listed for use as electrical or communications conduit.

626.03 Construction

Prior to commencing HDD work, the Contractor shall submit a drilling work plan to the Resident for approval addressing the following, at minimum:

- Profile of the proposed bore plotted at a scale appropriate for the crossing and acceptable to the Resident;
- HDD site layout including entry and exit points;
- Drilling fluid management plan, including drilling fluid types and specifications, cleaning and recycling equipment to be used, estimated flow rates, procedures for minimizing drilling fluid escape, and the method and location for final disposal of waste drilling fluids. Material safety data sheets shall be provided for all drilling fluid additives that will be used;
- Conduit storage and handling details;
- Summary of assembly and installation procedures to be used;
- Material safety data sheets of any other potentially hazardous substances to be used;
- Response plans for possible problems that may be encountered;

- Documentation and certification of the ability of the proposed conduit to withstand installation stresses and pressures.

The HDD drill rig and auxiliary pieces of equipment shall be appropriate for the diameter and length of conduit being installed. The power system shall provide sufficient pressure to power the drilling operations with a hydraulic system free from leakage. The directional drilling machine shall be anchored as necessary to stabilize it against excessive dislocation.
In order to minimize friction and prevent collapse of the bore hole, a soil stabilizing agent (drilling fluid) may be introduced into the annular bore space from the front end of the drill head to create a slurry. The drilling fluids shall be selected or designed for the site's specific soil and ground water conditions. The drilling fluid mixing system shall be self-contained and closed with sufficient size to mix and deliver drilling fluid to the drill head. The mixing system shall continually agitate the drilling fluid during drilling operations. The fluids delivery system shall be capable of pumping drilling fluid with sufficient volume and pressure from the mixing tank through the drill rods to the drill head.

Alignment of the bore shall be accomplished by proper orientation of the drill head as it is pushed through the ground by the drill rig. Orientation and tracking of the drill head shall be determined by using an acceptable tracking system from a transmitter located within the drill head. The HDD guidance system shall be capable of locating and tracking the drill head continuously and accurately both horizontally and vertically during the pilot bore. All equipment shall be properly calibrated before commencing the directional drilling operation. The alignment of the conduit shall remain at least 10 feet below the mainline traffic lanes and ramps at all times.

Borehole diameter relative to the conduit diameter shall be minimized to limit potential damage from soil displacement, settlement, and heaving. When necessary, the pilot borehole may be enlarged by back reaming to accommodate conduit larger than the pilot borehole size. Back reaming may be accomplished ahead of or at the same time as pulling the conduit through the pilot borehole. The back-reamer shall be sized to create a large enough borehole to allow cuttings to transfer from the face of excavation to the surface with minimum soil displacement.

Escaping slurry or drilling fluids shall be confined at the ground surface during pull back or drilling. All drilling fluids shall be disposed of or recycled in a manner acceptable to the Maine Department of Environmental Protection. Upon completion of the HDD operation, the work site shall be cleaned of all excess slurry or spoils. Any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid, or other damage from the directional drilling operation shall be repaired by the Contractor to the satisfaction of the Resident.

At the completion of the HDD conduit installation, the Contractor shall provide to the Resident marked up plans noting location, depth, and material type of all conduit installed by the Horizontal Directional Drilling method.

626.04 Method of Measurement

Horizontal Directional Drilled Conduit will be measured by the number of linear feet of conduit in place and accepted by the Resident.

626.05 Basis of Payment

Payment will be made for the total number of linear feet of Horizontal Directional Drilled Conduit and accepted at the contract price per linear foot. Payment shall include the cost of furnishing and installing the conduit; site preparation and restoration of drilling entry and exit points; removal of excavated material and drilling spoils; removal and disposal of drilling fluids and excess slurry; pull wire, fittings, grounding and bonding; test cleaning of conduit interior; and all other materials, labor, equipment, and incidentals necessary to complete the work. All wiring, as indicated on the plans, within the Horizontal Directional Drilled Conduit for highway lighting and traffic signal shall be incidental to this item. All wiring, as indicated on the plans, within the Horizontal Directional Drilled Conduit for toll power and communication shall be paid for at the unit price for the specific 655 wire/cable item.

Payment will be made under:

Pay Item		Pay Unit
626.223	Horizontal Directional Drilled Conduit	Linear Foot

SPECIAL PROVISION

SECTION 627

PAVEMENT MARKINGS

(White or Yellow Pavement Marking Line)

627.01 Description

The following sentences are added:

This work shall consist of furnishing and placing the final pavement markings at locations as shown on the Plans or as directed by the Resident.

The following sentence is added:

This work shall consist of furnishing and placing pavement marking paint and temporary pavement marking paint at locations as shown on the Plans or as directed by the Resident.

627.02 Materials

The following is added before the last paragraph:

The paint for pavement markings shall be 100% acrylic waterbase paint.

627.04 General

The following is added to the third paragraph:

Dotted white lines (DWL) shall consist of alternate 3 foot painted line segments and 9 foot gaps.

Permanent pavement marking paint shall be applied at the end of each work week prior to opening the work area to traffic or as approved by the Resident.

Temporary pavement marking paint and temporary pavement markers shall be applied daily prior to opening the work area to traffic during non-work hours or as approved by the Resident. Temporary pavement marking paint shall be re-applied at least once each construction season or as directed by the Resident Engineer.

627.08 Removing Lines and Markings

The last sentence is deleted and is not replaced.

627.09 Method of Measurement

The second and third sentences in the second paragraph are deleted and replaced with the following:

The measurement of broken white lines, both permanent and temporary and dotted white lines, will include the gaps when painted. Temporary painted pavement marking lines will be measured for payment by the linear foot.

627.10 Basis of Payment

This Subsection is deleted and replaced with the following:

The accepted quantity of white or yellow pavement marking lines will be paid at the Contract price per linear foot. This price shall include all labor and materials to furnish, and install the paint line.

The accepted quantity of broken and dotted white pavement marking lines will be paid at the Contract price per linear foot. This price shall include all labor and materials to furnish and install the paint line.

The accepted quantity of temporary white or yellow pavement marking lines will be paid at the Contract price per linear foot. This price shall include all labor and materials to furnish, install and maintain the paint marking.

Payment will be made under:

Pay Item		Pay Unit
627.712	White or Yellow Pavement Marking Line	Linear Foot

SPECIAL PROVISION

SECTION 627

PAVEMENT MARKINGS

(Temporary 6 Inch Pavement Marking Tape)
(Temporary 6 Inch Black Pavement Marking Tape)

627.01 Description

The following sentence is added:

This work shall also consist of furnishing, placing, maintaining and removing temporary pavement marking tape at locations shown on the Plans or as directed by the Resident.

This work shall also consist of furnishing, placing, maintaining and removing temporary black pavement marking tape at locations shown on the Plans or as directed by the Resident. Temporary 6 Inch Black Pavement Marking Tape shall be used to cover conflicting existing pavement marking paint.

627.02 Materials

The following paragraph is added:

Temporary pavement marking tape shall be Stamark Wet Reflective Removable Pavement Marking Tape Series 710 as manufactured by 3M of St. Paul, Minnesota or an approved equal.

Temporary pavement marking tape shall be Stamark Removable Black Line Mask Tape Series 715 as manufactured by 3M of St. Paul, Minnesota or an approved equal.

627.04 General

The following paragraphs are added:

Work under this item shall be in accordance with the manufacturer's recommendations. A factory representative from 3M shall be present for the first application of all temporary pavement marking tape to insure proper application and product performance.

The pavement markings shall be applied mechanically to clean dry pavement as recommended by the manufacturer and approved by the Resident.

Temporary pavement markings shall consist of applying six inch solid white, six inch broken white, and six inch yellow reflectorized pavement marking tape for traffic maintenance during construction as shown on the Plans or as directed by the Resident.

Temporary pavement marking tape that loses reflectivity, becomes broken, dislodged or missing during the life of the Contract shall be replaced by the Contractor at no additional cost to the Authority.

627.06 Application

The following paragraphs are added:

For application of the tape, when the pavement temperature is below 50°F, heat shall be applied to the pavement surface, if deemed necessary by the factory representative or as directed by the Resident, at no additional cost to the Authority. Proper primer for the temperatures shall be used as directed by the manufacture.

The pavement mark tape shall be rolled over with a vehicle once application is complete and then scored every 20 feet when placed in long runs to prevent full length unraveling.

627.08 Removing Lines and Markings

The following sentence is added:

Removal of temporary pavement marking tape shall be accomplished without the use of heat, solvents, grinding or sandblasting and in such a manner that no damage to the pavement results.

627.09 Method of Measurement

The following paragraph is added:

Temporary Pavement Markings – Tape will be measured for payment by the linear foot. The measurement of broken lines will not include the gaps.

627.10 Basis of Payment

The following paragraphs are added:

Payment for the Temporary Pavement Markings - Tape will be made at the Contract bid price per linear foot, which price shall include furnishing, installing, maintaining and removing the temporary tape and all materials, labor, equipment and incidentals necessary to accomplish the work. Replacement of Temporary Pavement Markings - Tape, as described above, will be incidental and no separate payment will be made.

Payment for the Temporary 6 Inch Black Pavement Marking Tape will be made at the Contract bid price per linear foot installed, which price shall include furnishing, installing, maintaining and removing the temporary tape and all materials, labor, equipment and incidentals necessary to accomplish the work. Replacement of 6 Inch Black Temporary Pavement Marking Tape, as described above, will be incidental and no separate payment will be made.

Payment will be made under:

Pay Item		Pay Unit
627.73	Temporary 6 Inch Pavement Marking Tape	Linear Foot
627.731	Temporary 6 Inch Black Pavement Marking Tape	Linear Foot

SPECIAL PROVISION

SECTION 627

PAVEMENT MARKINGS

(Temporary Raised Pavement Markers)

627.01 Description

The following sentence is added:

This work shall consist of furnishing, placing and removing temporary raised pavement markers at locations as shown on the Plans or as directed by the Resident.

627.02 Materials

The second paragraph is deleted and replaced with the following:

The temporary raised pavement markers for the Maine Turnpike and ramps shall be white or yellow one way markers (Type Tom W-1, Y-1, Grade WZ) as distributed by PEXCO LLC – Davidson Traffic Control Products, Tacoma, WA, or an approved equal. Colors shall conform to 2009 MUTCD requirements.

The temporary raised pavement markers for Route 112 shall be white or yellow two way markers (Type Tom W-2, Y-2 Grade WZ) as distributed by PEXCO LLC – Davidson Traffic Control Products, Tacoma, WA, or an approved equal. Colors shall conform to 2009 MUTCD requirements.

627.04 General

The following sentences are added:

Temporary raised pavement markers shall be used to delineate travel lanes on the Maine Turnpike (BWLL) after placement of the surface course (HMA 12.5 mm). Temporary raised pavement markers shall be used to delineate center line and lane lines on Route 112 after placement of the surface course (HMA 12.5 mm).

Temporary raised pavement marker that lose reflectivity, becomes broken, dislodged or missing during the life of the Contract shall be replaced by the Contractor at no additional cost to the Authority.

The spacing and number of temporary pavement markers installed as edge lines shall be the same as shown for the BWLL on the Plans for Temporary Pavement Marking.

627.09 Method of Measurement

The following sentence is added:

Temporary Raised Pavement Markers will be measured by each unit, complete in place, maintained and accepted.

627.10 Basis of Payment

The following paragraphs are added:

The accepted quantity of Temporary Raised Pavement Markers white and/or yellow will be paid for at the Contract price each. This price shall include all labor and materials to furnish, install, maintain, and remove the markers.

Payment will be made under:

Pay Item		Pay Unit
627.812	Temporary Raised Pavement Markers	Each

SPECIAL PROVISION

SECTION 627

PAVEMENT MARKINGS

(Pavement Marking Tape)
(Pavement Marking Tape – Dotted White Lane Line, 6-inch Width)
(Pavement Marking Tape – Dotted White Lane Line, 12-inch Width)

627.01 Description

The following sentence is added:

This work shall consist of furnishing and placing reflective pavement marking tape in conformity with the Plans, as specified herein and as directed by the Resident.

The pavement marking tape shall be installed at all locations.

627.02 Materials

The following sentence is added:

For the Broken White Lane Line (BWLL), Pavement Marking Tape shall be 3M Stamark™ High Performance Tape Series 380AW – High Performance pavement marking tape, color- white, six (6) inch width, as manufactured by 3M of St. Paul, Minnesota.

For the Dotted White Lane Line (DWLL), Pavement Marking Tape shall be 3M Stamark™ High Performance Tape Series 380I ES – High Performance pavement marking tape, color- white, six (6) inch wide and twelve (12) inch wide, as manufactured by 3M of St. Paul, Minnesota.

3M Traffic Safety Systems Division
Mr. Michael D. Allen
Tel: (401) 368-0438
Email: mdallen@mmm.com

627.04 General

The following paragraphs are added:

The tape shall be used as a supplemental broken white lane line. The tape shall be installed between the painted Broken White Lane Line (BWLL) spaced eighty (80) foot center to center as shown on the Plans. The length of the tape shall be three (3) feet.

The tape shall also be used to mark a Dotted White Lane Line (DWLL) and shall be installed on parallel deceleration and acceleration lanes at locations as noted in the Plans. On deceleration lanes, the tape shall be installed from the beginning of the full width deceleration lane and shall extend to the theoretical gore markings. On acceleration lanes, the DWLL shall extend from the theoretical gore markings to a point one-half of the total length of the acceleration lane

(including the lane taper length). Layout data is noted on the Plans. Dotted White Lane Line tape shall be three (3) foot in length and shall be spaced nine (9) feet apart. Spacing from the Solid White Lane Line (SWLL) or the Theoretical Gore Markings shall be nine (9) feet.

627.05 Preparation of Surface

The following paragraph is added:

The Contractor shall mill a groove in the pavement for each tape length to be placed ("in-and-out" pattern). Continuous grooving for installation of the tape shall not be allowed. The groove length shall be the required tape length plus 12 inches on both ends. Tape length spacing shall be as shown on the plans. The groove width for inlaid tape pavement marking shall be the pavement marking width plus 1 inch, with a tolerance of ± ¼ inch. The groove shall have a uniform depth of 150 Mils (±20 Mils). Groove position shall be a minimum of 2 inches from the edge of the pavement marking to the longitudinal pavement joint. The bottom of the groove shall have a smooth, flat finished surface. The use of gang stacked Diamond cutting blades is required for asphalt pavement surfaces. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades.

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. The Contractor shall prevent traffic from traversing the grooves, and re-clean grooves, as necessary, prior to application of the primer and pavement marking tape. Depth plates shall be provided by the contractor to assure that desired groove depth is achieved.

Reference is made to 3M Information Folder 5.18 Grooving Applications, May 2011, "Application Guidelines for Pavement Marking in Grooved Pavement Surfaces."

627.09 Method of Measurements

The following paragraph is added:

The quantity of Pavement Marking Tape measured for payment will be the linear feet of tape in place and accepted. The measurement will not include the gaps.

627.10 Basis of Payment

The following paragraphs are added:

The accepted quantity of pavement marking tape will be paid for at the Contract unit price per linear foot which price shall include all material, pavement grooving, equipment, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
627.94	Pavement Marking Tape	Linear Foot
627.941	Pavement Marking Tape – Dotted White Lane Line, 6-inch Width	Linear Foot
627.942	Pavement Marking Tape – Dotted White Lane Line, 12-inch Width	Linear Foot

SPECIAL PROVISION

SECTION 627

PAVEMENT MARKINGS

(Recessed Pavement Marking Tape)

627.01 Description

The following sentence is added:

This work shall consist of furnishing and placing recessed, reflective pavement marking tape in conformity with the Plans, as specified herein and as directed by the Resident.

627.02 Materials

The following sentence is added:

Pavement Marking Tape for lane designation words, arrows, and stop bars shall be pre-cut by the manufacturer, and shall be 3M Stamark Extended Season Tape Series 380IES– High Performance pavement marking tape, color - white, as manufactured by 3M of St. Paul, Minnesota.

3M Traffic Safety Systems Division
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627.05 Preparation of Surface

The following paragraph is added:

The Contractor shall mill a groove in the pavement for each tape length or area to be placed ("in- and-out" pattern). Continuous grooving for installation of the tape shall not be allowed. The groove length shall be the required tape length plus 12 inches on each end. Tape length spacing shall be as shown on the plans. The groove width for inlaid tape pavement marking shall be the pavement marking width plus 1 inch, with a tolerance of ± ¼ inch. The groove width for inlaid tape pavement areas shall be the pavement marking width plus 3 inches, with a tolerance of ± 1 inch. The groove shall have a uniform depth of 150 Mils (±20 Mils). Groove position shall be a minimum of 2 inches from the edge of the pavement marking to the longitudinal pavement joint.

The bottom of the groove shall have a smooth, flat finished surface. The use of gang stacked Diamond cutting blades is required for asphalt pavement surfaces. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades.

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. The Contractor shall prevent traffic from traversing the grooves, and re-clean grooves, as necessary, prior to application of the primer and pavement marking tape. Depth plates shall be provided by the contractor to assure that desired groove depth is achieved.

Reference is made to 3M Information Folder 5.18 Grooving Applications, May 2011, "Application Guidelines for Pavement Marking in Grooved Pavement Surfaces."

627.09 Method of Measurements

The following paragraph is added:

The accepted quantity of Pavement Markings – Recessed Tape – Words, Arrows, Stop Bars will be measured for payment by the square foot in place and accepted. The square foot areas of the Words and Arrows will be the areas posted in the Pavement Marking section of the MaineDOT Standard Details.

627.10 Basis of Payment

The following paragraphs are added:

The accepted quantity of Pavement Markings – Recessed Tape - Words, Arrows, Stop Bars will be paid for at the Contract unit price per square foot which price shall include all material, pavement grooving, equipment, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
627.944	Pavement Markings – Recessed Tape – Words, Arrows, Stop Bars	Square Foot

SPECIAL PROVISION

SECTION 631

EQUIPMENT RENTAL

631.02 General

The following sentences are added:

Bucket truck - Approved one man, able to reach 30 feet high bucket truck with 10 feet lateral extension.

Scissor Lift - Hydraulic scissors lift with a minimum capacity of three workers.

Electrician - Licensed by State of Maine.

Electrician's Apprentice - Enrolled in an accredited program.

631.08 Basis of Payment

The following paragraphs are added:

Such related costs such as use of hand tools, meal and room expenses, benefits, insurance, retirement, travel time, overtime, overhead and profit will not be measured separately for payment, but shall be incidental to the unit price for the bid item.

Note: For extra materials required for miscellaneous work the General Contractor shall be allowed 15 percent overhead and profit on the cost of materials and rental equipment (not covered by miscellaneous unit items). Rates for Subcontractor owned equipment required to perform miscellaneous work, not otherwise provided for in the Contract, shall be negotiated.

The General Contractor will be allowed 10 percent overhead and profit on the subcontractor's cost of materials, and subcontractors rented equipment (not covered by miscellaneous unit items). The General Contractor shall include his markup on the Subcontractor's labor in the pay items.

The labor hour bid items shall include labor and labor burdens, benefits, supervision, transportation, travel time and allowances, overnights, small tools and equipment, subcontractor overhead and profit, and General Contractor overhead and profit. Time will be measured from the start of work to the stoppage of work at the project site; less the time taken for lunch. No deduction of time will be taken for the standard morning "coffee break".

Payment will be made under:

Pay Item		Pay Unit
631.51	Bucket Truck	Hour
631.52	Scissor Lift	Hour
631.53	Electrician	Hour
631.54	Electrician's Apprentice	Hour
631.55	Plumber	Hour

SPECIAL PROVISION

SECTION 633

GAS UTILITY

(Propane Service)
(Natural Gas Service)

633.01 Description

This work shall include furnishing and installing two 1,000 gallon above ground propane tanks at the Southbound Toll Administration Building, manifold piping between the propane tanks including a primary regulator, HDPE propane service line from the tanks to the generator, Corrugated Stainless Steel tubing from the tanks to the toll booth cabinet unit heater secondary regulator, and 16" x 16" x 8" PVC Junction Boxes in Islands A and C front booth bumpers including all excavation, backfill, compaction, coordination, materials and equipment.

This Work shall consist of constructing a utility trench for the installation of the natural gas service connection line from the main at Route 112 to the Northbound Toll Administration Building, furnishing and installing the HDPE natural gas service line from the Northbound Toll Administration Building to the generator, Corrugated Stainless Steel tubing from natural gas service connection to the toll booth cabinet unit heater secondary regulator, and 16" x 16" x 8" PVC Junction Boxes in Islands A and B front booth bumpers including all excavation, backfill, compaction, coordination, materials and equipment.

This Work shall consist of constructing a utility trench for the installation of the natural gas service connection line from the main at Route 112 to the existing Hotel service line including all excavation, backfill, compaction, coordination, materials and equipment.

633.02 Materials

The aboveground 1,000 Gallon Propane Tanks shall be furnished new not refurbished, with a manufacture date within 24 months of installation.

The aboveground propane tanks shall meet the following requirements:

Designed and constructed in accordance with the ASME Section III, Division 1
Code. Registered with the National Board of Boiler & Pressure Vessels
Inspectors Complies with NFPA 58
TGIC polyester powder
paint Painted Sky White
Tanks fully fitted with RegO valves and Rochester liquid level
gauges Container pressure rated at 250 psi @ 400 deg F
Vacuum Purged
Stainless steel data
plate Steel Dome
#54 liquid level outage valve orifice

The Generator Natural Gas Service Line (Northbound) shall be ¾" High Density Polyethylene distribution pipe meeting the requirements of ASTM D 2513.

The Generator Propane Service Line (Southbound) shall be 1" High Density Polyethylene distribution pipe meeting the requirements of ASTM D 2513.

The toll booth cabinet unit heater natural gas service line (Northbound) and propane service line (Southbound) shall be ½" (size 18 EHD) Corrugated Stainless Steel Tubing (CSST) to be manufactured by Gastite® (or approved equal) corrugated stainless steel tubing complying with ANSI LC 1 "Fuel Gas Piping Systems Using CSST" and listed with CSA®, ICC and IAPMO. Manufacturing materials to be ASTM A240 type 300 corrugated stainless steel tubing with a minimum wall thickness of 0.010", jacketing of UV resistant polyethylene meeting the requirements of ASTM E84 for flame spread and smoke density. All mechanical tube fittings are SAE CA360 brass incorporating double wall flare sealing and Jacket-Lock™ jacket capturing for steel tubing protection.

Backfilling shall consist of placing suitable material in all spaces excavated and not occupied by the utility lines up to the loam elevation. Backfill shall be granular borrow placed at or near optimum moisture content and shall not contain stones larger than three inches, frozen lumps, chunks of clay, organic matter or other objectionable material.

Sand borrow bedding material shall meet the requirements of Subsection 703.01.

633.03 Construction

The Contractor shall coordinate the construction of the Propane Service with the Authority's propane supplier, through the Resident. Backfill of the propane gas piping shall be in accordance with Section 206, Structural Excavation.

The Contractor shall coordinate the construction of the utility trench with Unitil, through the Resident. Backfill shall be in accordance with Section 206, Structural Excavation. Natural gas lines shall be furnished and installed by Unitil. Excavation, bedding and backfill shall be completed by the Contractor.

Warning tapes shall be a metallic/detectable type made of solid yellow film with continuously printed black-letter caption: "CAUTION—PROPANE GAS BURIED BELOW" or "CAUTION—NATURAL GAS BURIED BELOW." The warning tape shall be metallic warning tape manufactured for marking and identifying underground utilities, six inches wide and a minimum of four mils thickness, continuously inscribed with a description of the utility.

633.04 Method of Measurement

Propane Service shall be measured by the Lump Sum complete and accepted.

Natural Gas Service shall be measured by the Lump Sum complete and accepted.

633.05 Basis of Payment

Natural Gas Service shall be paid for at the Contract unit price per lump sum, which shall be full compensation for furnishing and installing piping, regulators, shut off valves and all excavation, backfill, compaction, coordination, materials, equipment, and incidental items necessary

to complete the work to the satisfaction of the Resident.

Propane Service shall be paid for at the Contract unit price per lump sum, which shall be full compensation for furnishing and installing propane tanks, piping, regulators, shut off valves and all excavation, backfill, compaction, coordination, materials, equipment, and incidental items necessary to complete the work to the satisfaction of the Resident.

Payment will be made under:

Pay Item		Pay Unit
633.031	Natural Gas Service – Northbound	Lump Sum
633.0311	Natural Gas Service – Hotel	Lump Sum
633.032	Propane Service – Southbound	Lump Sum

SPECIAL PROVISION

SECTION 633

GAS UTILITY

(Propane Tank Supports)

633.01 Description

This work shall consist of furnishing and placing Portland Cement concrete for the propane tank supports in accordance with these Specifications and in conformity with the lines, grades, and dimensions shown on the Plans.

633.02 Materials

Materials shall meet the following requirements: Concrete shall be Class "A" concrete

(f'c-4000 psi). Gravel shall meet the requirement for Section 703.06b.

Peastone shall conform to ASTMC33 Grading 7 (Peastone).

633.03 Propane Tank Supports

The Contractor shall coordinate the location and spacing of the supports for the tanks with the propane gas supplier prior to any excavation. The Contractor has the option of using precast or cast-in-place supports as dimensioned in the plans. The supports shall be constructed/placed on a six inch layer of peastone. After the supports have been set to line and grade the cavity shall be backfilled with aggregate subbase material. The aggregate material shall be firmly compacted in layers not more than eight inches, loose measure. Backfilling of the supports material shall conform to Subsection 206.03.

633.04 Method of Measurement

Propane Tank Supports satisfactorily placed and accepted shall be measured by each unit.

633.05 Basis of Payment

The accepted quantity of Propane Tank Supports will be paid for at the Contract unit price each for the number of units installed. Payment shall be full compensation for excavation, construction or placement of support, peastone and gravel, backfilling and all equipment, labor and incidentals necessary to complete the work.

The top six inches of peastone and weed control fabric will not be paid for under this item, but shall be paid for under Item 633.31, Propane Tank Pad.

Payment will be made under:

Pay Item		Pay Unit
633.21	Propane Tank Supports	Each

SPECIAL PROVISION

SECTION 633

GAS UTILITY

(Propane Tank Pad)

633.01 Description

This work shall consist of excavating, and placing peastone for the construction of a propane tank pad in accordance with these Specifications and in reasonably close conformity with the lines, grades and typical sections shown on the Plans orestablished.

633.02 Materials

Materials shall meet the following requirements:

Peastone shall conform to ASTMC33 Grading 7 (Peastone).

633.03 General

The Contractor shall excavate area for the pad to the dimensions shown on the Plans or as directed by the Resident. Weed control fabric shall be placed on the bottom and sides of the excavated area and shall be overlapped as recommended by the manufacturer. A layer of peastone shall then be placed on the fabric to the required depth as shown on the Plans.

633.04 Method of Measurement

The quantity of Propane Tank Pad will be measured by the number of square yards of surface covered, complete and accepted.

633.05 Basis of Payment

The Propane Tank Pad will be paid for at the Contract unit price per square yard, complete and accepted. Payment shall be full compensation for all excavation, peastone, weed control fabric, tools, equipment, labor and all incidentals necessary to complete thework.

The weed control fabric will not be measured separately for payment, but shall be incidental to this pay item.

Payment will be made under:

Pay Item		Pay Unit
633.31	Propane Tank Pad	Square Yard

SPECIAL PROVISION

SECTION 634

HIGHWAY LIGHTING

(Remove High Mast Light Standard)
(Replacement LED Fixture – Supplied by The Authority)
(High Mast Light Standard – Supplied by The Authority)
(Remove and Reset Light Standard)
(Conventional Light Standard with LED Fixture – Supplied by The Authority)

634.01 Description

The following paragraphs are added:

The work shall consist of verifying the voltage of existing luminaires and circuits, removing the existing luminaires and, if called for on the plans, furnishing and installing new LED luminaires with all new associated appurtenances at locations shown.

The work shall consist of removing existing light standards, luminaires, and any breakaway devices and their associated foundations, and resetting with associated appurtenances and wiring systems on new concrete foundations with new LED luminaires at locations as shown on the Plans.

The work shall consist of removing existing light standards, luminaries, and any breakaway devices, and their associated foundations. All existing light standards and associated appurtenances removed and not reset by the Contractor shall become the property of the Contractor. All LED luminaires removed shall be reused and any unused LED luminaires shall remain the property of the Authority. All non-LED luminaires removed, unless otherwise noted, will become the property of the contractor.

The work shall consist of installing a new high mast light standard supplied by the Authority, including all appurtenances at locations shown. The high mast light standard supplied by the Authority will be available at the MTA Crosby Maintenance Facility MM 45.8 Southbound

The work shall consist of installing new conventional light standards with LED fixtures supplied by the Authority, at mainline, ramp and toll plaza locations and installing replacement LED fixtures supplied by the Authority on dual purpose poles at intersections and exit toll points as shown on the plans. This shall include all appurtenances. Conventional light standards with LED fixtures supplied by the Authority and replacement LED fixture – supplied by the Authority will be available at the MTA Sign Shop at MM 58 NB.

Existing lighting shall remain operational at all times until new luminaires are installed and operational. Existing luminaires, conduit and lighting standards shall be protected until approved by the Resident to be removed. Any temporary lighting that may be needed during removing and resetting of existing light standards shall be incidental to the 634 items. Existing lighting for the Old Exit 5 (Sta. 1715+25 to 1719+25, Rt.) shall be maintained until the High Mast Light HM-35 is operating.

634.02 General

First sentence of second paragraph shall be replaced:

All electrical equipment shall conform to NEMA, UL or EIA standards and conduit used for conductors shall conform to NEMA or UL standards and listed certification by a Nationally Recognized Testing Laboratory.

The following paragraphs are added:

All Contract work shall be overseen by a Maine licensed Master Electrician. The lead person for the field installations shall be either a Maine licensed Master Electrician, or a Maine licensed Journeyman Electrician. Apprentice Electricians, Helper Electricians, Journeyman-In-Training Electricians, and helpers may work under the Master or Journeyman Electrician as permitted under the law.

The Contractor shall comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical cable, wire and connectors; provide electrical cable, wire and connectors, which have been listed and labeled by Underwriters Laboratories, and comply with National Electrical Manufacturers Association/Insulated Power Cable Authorities Association Standards publications pertaining to materials, construction and testing wire cable, where applicable.

At a minimum, the Contractor shall provide the following field quality control:

- Prior to energizing, check wire for continuity of circuitry and for short circuits with ohmmeter type testing equipment. Correct malfunction when detected.
- Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

634.021 Materials

The following paragraphs are added:

Disconnect fuse kits in pole bases shall be Ideal SLK Disconnect Fuse Kit 30-S2212, or similar approved Ideal SLK Disconnect Fuse Kit, matched to the pole wiring configuration.

The 120-277V Conventional Multi-Tap LED fixtures shall be one of the following:

- Model # ATB2-60BLEDE70-MVOLT-R3-NL-PCLL, as manufactured from American Electric Lighting
- Model # ATB2-80BLEDE70-MVOLT-R3-NL, as manufactured from American Electric Lighting

The 480V Conventional LED fixtures shall be one of the following:

- Model # ATB2-60BLEDE70-480VOLT-R3-NL, as manufactured from American Electric Lighting
- Satellite Series # SAT-96M-7-R-T3- 600GY-1-A-NS, as manufactured by LED Roadway Lighting of Halifax, Nova Scotia; (877) 533-5755

- LEDway Series # STR-LWY 3M HT 08 E UH SV 700 R, as manufactured by CREE, Inc., 4600 Silicon Drive, Durham, NC 27703
- Signify/Lumec Roadview LED Series RVS-135W80LED4K-LE3-HVU-GY3, as manufactured by Signify/Lumec,

The Contractor may submit an alternate LED fixture for review and acceptance or rejection. Alternate LED fixtures will need to meet or exceed the performance and efficiency of the specified fixtures. Should the Authority not accept the Contractor's proposed substitution the Contractor shall provide the specified fixture at no additional cost to the Authority.

Splices in junction boxes shall be made with Burndy UGS350ULDB Direct Burial/Submersible Splice Wire Range #12 AWG – 350KCMIL connectors for the appropriate wire count only.

The Manufacturer shall provide a minimum 5-year warranty on all fixtures, installed and spares, from the Project Completion date.

Each luminaire shall be provided with a 3 pin NEMA receptacle, a photocell and a shorting cap. All "spare" photocells and shorting caps shall become property of the Authority.

All fixtures shall be submitted and approved before the fixtures are ordered. Submittals shall include Product Data sheets clearly identifying the product and accessories being proposed, Test Reports and Certifications, and Product Warranties.

This item shall include the providing and installation of all AWG XHHW grade wire for highway lighting, as described herein, including grounding wires (where applicable), for all locations called for in the plans/specifications. All wire installed in conduit must be copper and direct burial grade, suitable for wet locations. The Contractor shall leave 18" of wire slack at each handhole. Payment for all wiring for highway lighting will be incidental to the 634 items.

634.04 Cable Installation

The reset light standards that do not have a disconnect fuse kit or have a damaged or un-suitable disconnect fuse kit in the pole base, shall have a new disconnect fuse kit installed. The work will be included in the payment for reset light standard.

The reset light standards where the existing wire(s) at the luminaire or base are brittle and there is insufficient slack in the wire(s) to cut out the brittle portions of wire(s) and properly reset the light standard, shall have new wire(s) installed from the LED fixture to the (existing or new) disconnect fuse kit in the pole base. The work will be included in the payment for reset light standard.

634.051 Removing Light Standards

The first paragraph is deleted and replaced with the following:

Before removing light standards, the luminaires shall be removed from the light standard and stacked.

The Contractor will not be allowed to remove the existing light standards until all new foundations, wiring, conduits and junction boxes have been installed. Existing light levels shall be maintained while new light standards are being installed and made fully operational. New breakaway devices and mounting hardware shall be required on all reset and proposed light standards. If breakaway devices do not exist on the existing light standard, new breakaway devices shall be supplied and installed. For all entrance ramp, exit ramp, interchange, and toll plaza lighting locations, the Contractor will be allowed the daylight hours within one (1) working day to remove and reset a light standard, including installing the luminaire and testing.

634.06 Luminaires

The second paragraph is revised to read:

The connections between the luminaires and connector kits shall be made with number 10 wires AWG copper stranded XHHW, minimum size. A 14-inch-long Teflon sleeve shall be placed over each end of each conductor in the luminaire.

634.092 Method of Measurement

The following sentence is added:

Remove High Mast Light Standard will be measured by the unit.

High Mast Light Standard – Supplied by The Authority will be measured by the single unit, complete in place and accepted.

Replacement LED Fixture – Supplied by the Authority and Remove and Reset Light Standard will be measured by the single unit, complete in place and accepted.

Conventional Light Standard with LED Fixture – Supplied by The Authority will be measured by the single unit, complete in place and accepted.

634.093 Basis of Payment

The following paragraphs are added:

Verifying the voltage of the existing luminaire(s) before installing the new LED luminaire(s) will not be paid separately but shall be incidental to the Replacement LED Fixture pay item.

Confirming if the existing pole(s) have a disconnect fuse kit in the base, providing and installing if none present, will not be paid separately, but shall be incidental to the Replacement LED Fixture, Remove and Rest Light Standard, and Conventional Light Standard pay item.

Payment for Remove High Mast Light Standard will be made for the accepted quantity at the Contract unit price each, which shall include removing and disposing of the High Mast light standard and the removal, delivery and stacking of the High Mast luminaries, associated electrical equipment and head frame assembly, and carriage ring on top of the pole at the MTA Crosby

Maintenance Facility along the Turnpike Southbound at MM 45.8. Payment for the removal of the foundations will be made under item 626.36 – Remove or Modify Concrete Foundation.

Payment for Replacement LED Fixture – Supplied by The Authority will be made for the accepted quantity at the Contract unit price each. Payment shall be full compensation for loading, transporting Replacement LED Fixture from the MTA Sign Shop at MM 58 to the project site, installing the bracket arm, new LED luminaire, driver, fixture mounted shorting cap at photocell receptacle, as supplied by the Authority and provide disconnect fuse kit, and all incidentals to complete the work.

Payment for High Mast Light Standard – Supplied by The Authority will be made for the accepted quantity at the Contract unit price each. Payment shall be full compensation for loading, transporting light standards from the MTA Crosby Maintenance Facility MM 45.8 Southbound to the project site, installing the light standard, breakaway device, bracket arm, new LED luminaire, driver, fixture mounted shorting cap at photocell receptacle, as supplied by the Authority and provide disconnect fuse kit, and all incidentals to complete the work.

Payment for Remove and Reset Light Standard will be paid at the Contract unit price each for the number of units that are removed and reset. Payment shall be full compensation for the removal and resetting of the light standard, including luminaires, new breakaway device installed, new pole wires, new disconnect fuse kit, removal and delivering existing precast foundations suitable for reuse to the MTA Crosby Maintenance Facility along the Turnpike Southbound at MM 45.8, and all incidentals necessary to provide a complete and working light standard as shown on the plans.

Payment for Conventional Light Standard with LED Fixture – Supplied by The Authority will be made for the accepted quantity at the Contract unit price each. Payment shall be full compensation for loading, transporting light standards from the MTA Sign Shop at MM 58 to the project site, installing the light standard, breakaway device, bracket arm, new LED luminaire, driver, fixture mounted shorting cap at photocell receptacle, as supplied by the Authority and provide disconnect fuse kit, and all incidentals to complete the work.

Payment will be made under:

Pay Item		Pay Unit
634.052	Remove High Mast Light Standard	Each
634.1751	Replacement LED Fixture – Supplied by The Authority	Each
634.2078	High Mast Light Standard – Supplied by The Authority	Each
634.208	Remove and Reset Light Standard	Each
634.2312	Conventional Light Standard with LED Fixture - Supplied by The Authority	Each

SPECIAL PROVISION

SECTION 636

DESIGN OF SOIL NAIL WALL

636.01 Description

This work shall consist of designing, engineering, and detailing a permanent soil nail retaining wall at the location shown on the Drawings. The Contractor shall furnish all labor, plans, drawings, design calculations, and all other material and equipment required to design the soil nail wall in accordance with MaineDOT Standard Specifications and these Special Provisions.

The work shall include the determination of the staged excavation lifts; design and detailing the of the soil nails, grout and drillholes to the diameter and length required to develop the required capacity; design and detailing of soil nail anchorages including bearing plates, washers, nuts and other required miscellaneous material; design and detailing of any supplemental abutment tie-backs that may be required; design and detailing of drainage features and miscellaneous wall appurtenances; design and detailing of the required temporary shotcrete face; and design and detailing of the final cast-in-place concrete facing and coping.

636.02 General Requirements

Design the soil nail wall in accordance with the AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020 with the latest interim specifications, and the procedures contained in FHWA Geotechnical Engineering Circular No. 7 “Soil Nail Walls Reference Manual”.

Soil/rock design shear strength parameters, slope and external surcharge loads, seismic design coefficient, type of wall facing, architectural treatment, corrosion protection requirements, easements, and right-of- ways will be as specified herein and shown on the Contract Drawings.

Detailed Shop Drawings and design calculations, stamped and signed by a Professional Engineer licensed in the State of Maine and specializing in geotechnical engineering, shall be submitted to the Authority for review and approval.

It is not the intent of these Special Provisions to provide detailed step-by-step instructions for the design and execution of the work or to identify each material or component to be supplied or each item of work or coordination to be performed. However, the Plans, the Special Provisions, and the MaineDOT Standard Specifications do delineate the general design intent with regard to lines and grades, appearance, materials, type of construction, physical requirements, relationships of elements, and the type and quality of construction required. Where specific details, sequences, relationships, requirements and materials are shown or specified, they shall be strictly adhered to and provided. Where such information is not provided, is only partially provided, or is addressed only in a general nature, it shall be the Contractor’s responsibility to provide or fully develop such information and submit the same for the Authority’s approval. This shall include comprehensive, coordinated, detailed design and Shop Drawings, drawings of existing and adjacent conditions, design calculations, product data, test results, installation instructions and sequencing, and all other information required for a complete evaluation by the Engineer of proposed materials, details, systems, quality and thoroughness of work.

It shall be solely the Contractor's responsibility to provide all required design, engineering, detailing, and materials and to perform the work by such means and methods as will facilitate a construction that is complete in all respects, all to the satisfaction of the Authority.

It shall be the responsibility of the Contractor and their soil nail wall system designer to review both the soil data in the Geotechnical Design Report (GDR) and the proposed application of soil nail wall system to account for appropriate drainage needs and incorporate into the design. A positive drainage system shall be included in the design and construction, comprising geocomposite drain strips, PVC connection pipes, and wall underdrain.

A qualified representative of the wall designer shall be onsite for a minimum of four (4) hours each day while wall construction is performed to monitor and approve construction methods until such time that the first level of soil nails and shotcrete are placed. Thereafter, said representative(s) shall be onsite at least two days each week (for a minimum of four (4) hours per day) until the work is complete, to ensure that the Contractor's procedures satisfy the intent of the design. No separate or additional payment will be made for complying with these requirements.

636.03 Available Information

Available information developed by the Authority or the Authority's duly authorized Representative includes the following items:

1. Drawings prepared by Stantec, Inc.

2. Geotechnical Design Report prepared by Stantec, Inc. entitled, "Geotechnical Design Report, Maine Turnpike Exit 35 and 36 Interchange Improvements, Saco, Maine."

636.04 Contractor's Design Experience Requirements

The Contractor shall submit a detailed resume of the soil nail wall designer, listing similar projects and demonstrating the necessary experience to perform the soil nail wall design, including a brief description of each project that is similar in scope. A reference shall be included for each project listed. As a minimum, the reference shall include the owner's name, address and current phone number. The wall designer shall have experience in the design of at least three successfully completed permanent soil nail retaining wall projects over the past three years. The soil nail wall designer shall be a licensed Professional Engineer in the State of Maine specializing in geotechnical engineering and shall have worked on the above projects. The soil nail wall design submittal shall be stamped by this individual.

636.05 Soil Nail Wall Design Submittals

The Contractor shall submit complete and accurate shop drawings to the Authority for approval. It shall be understood that all submittals must gain acceptance of the Authority and shall be resubmitted as many times as necessary for such acceptance, without giving rise to any claims for additional compensation or extension to the time of completion.

The shop drawings shall show the configuration and all details, dimensions, quantities and cross-sections necessary to construct the wall, including but not limited to, the following:

1. A plan view of the wall(s) identifying:

    a. A reference baseline and elevation datum.
    b. Beginning and end of wall stations.
    c. Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures or other potential interferences. The centerline of any drainage structure or drainage pipe behind, passing through, passing under or passing near the wall.
    d. Limit of longest nails.
    e. Subsurface exploration locations shown on a plan view of the proposed wall alignment with appropriate reference base lines to fix the locations of the explorations relative to the wall.

2. An elevation view of the wall identifying:

    a. The elevation at the top of the wall, at all horizontal and vertical break points, and at least every 30 ft along the wall.
    b. Elevations at the wall base.
    c. Beginning and end of wall stations.
    d. The distance along the face of the wall to all steps in the wall base.
    e. Wall elevation view showing nail locations and elevations, vertical and horizontal nail spacing, and the location of wall drainage elements.
    f. Existing and finish grade profiles both behind and in front of the wall.

3. Design parameters and applicable codes.

4. General notes for constructing the wall including construction sequencing and other special construction requirements.

5. A listing of the summary of quantities on the elevation drawing of each wall showing estimated square feet of wall face areas.

6. Nail wall typical sections including staged excavation lift elevations, wall and excavation face batter, nail spacing and inclination, nail bar sizes, and corrosion protection details.

7. A typical detail of production and test nails defining the nail length, minimum drillhole diameter, inclination, and test nail bonded and unbonded test lengths.

8. Details, dimensions, and schedules or all nails, reinforcing steel, wire mesh, bearing plates, headed studs, etc. and/or attachment devices for shotcrete and cast-in-place facings.

9. Dimensions and schedules of all reinforcing steel including reinforcing bar bending details.

10. Removal limits of the existing concrete slope protection and proposed limits of the new concrete slope protection and drainage gutter along the back of the soil nail wall.

11. Details and dimensions for wall appurtenances such as barriers, coping, drainage gutters, concrete slope protection, fences, etc.

12. Details and dimensions for abutment tie-back systems, if required.

13. Details for constructing walls around drainage facilities.

14. Details of sleeves and pipes and other embedded items to be installed through the wall, if any.

15. Details for terminating walls and adjacent slope construction.

16. Facing finishes for permanent wall facings.

17. Location of utilities, if any.

18. Method of maintaining stability of excavations.

19. Excavation support system, if any.

20. Any acceptance testing and frequency.

21. Details and location of all necessary construction and expansion joints along the wall.

The Contractor shall also submit design computations, demonstrating compliance with the criteria specified herein and shown on the Drawings. They shall be prepared, signed, and stamped by a registered professional engineer licensed in the State of Maine and specializing in geotechnical engineering.

Design calculations shall include, but not be limited to the following items:

1. A written summary report which describes overall soil nail wall design.

2. Applicable code requirements and design references.

3. Nail wall critical design cross section(s) geometry including soil strata and location, magnitude and direction of design slope or external surcharge loads, and phreatic surface level(s).

4. Design criteria including soil shear strengths (friction angle and cohesion), unit weights, ground-grout pullout resistances, nail drillhole diameter assumptions for each soil strata.

5. Load and resistance factors used in the design on the pullout resistance, surcharges, soil unit weights, nail head strengths, and steel, shotcrete, and concrete materials. Minimum required global stability soil factor of safety.

6. Seismic design acceleration coefficient.

7. Recommendations for drainage behind the wall including the type and spacing of prefabricated drainage elements and other information.

8. Calculations of estimated horizontal and vertical wall deflections.

9. Calculations of estimated horizontal and vertical deflections of the adjacent west stub abutment of the existing I-195 Overpass Bridge, as well as design calculations for any supplemental tie-back anchorage systems that may be required to limit the horizontal and vertical movements of the existing abutment to the criteria contained in Special Provision 636 – Soil Nail Construction Monitoring – Existing Bridge.

10. Design calculation sheets with the project number, wall location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page with the design calculations.

11. Design notes including an explanation of any symbols and computer programs used in the design.

12. Nail wall final design cross-section(s) geometry including soil strata and location, magnitude and direction of slope or external surcharge loads, and phreatic surface level(s), with critical slip surface shown along with minimum calculated global stability soil factor of safety and required nail lengths and strengths (nail bar sizes and grades) for each nail row.

13. Structural design calculations for wall facing and nail head/facing connections including consideration of facing flexural and punching shear strength, headed studs tensile strength, upper cantilever, minimum reinforcement ratio, cover and splice requirements.

14. Information pertaining to the Cast-in-place wall and the Cast-in-place single slope barrier including reinforcing details, connections, and other information.

15. Analysis demonstrating the durability and corrosion resistance of retaining wall systems for the proposed location and environment.

16. Construction considerations such as construction working berms, maintaining the stability of the cut face prior to shotcreting, and other relevant considerations.

The Contractor shall also submit the manufacturer's product data for the soil nail wall system, including material, manufacture and erection specifications, all specialized erection equipment necessary, special details required of reinforcing layout, and design properties.

The Contractor's soil nail wall design submittal(s) shall be sufficiently detailed and complete such that an independent soil nail wall Contractor would have all the necessary information to construct the soil nail wall in accordance with the soil nail wall design.

636.06 Special Design Conditions Specific to this Project

Specific comments relative to design of Soil Nail Walls for this project are provided below. Reference should be made to the available information (Special Provision 636 - Soil Nail Wall) for additional information.

Man-Placed Fill, Stand-Up time, and the Potential for Nail Hole Caving.
The Geotechnical Design Report for the project indicated that the man-placed embankment fill at the existing west abutment for the I-195 Overpass Bridge consists of a medium dense to very dense sand. The Contractor should be aware that loose man-placed fill soil could be present in localized areas and could have a relatively low strength. As a result, special design provisions such as closer nail spacing, longer nails, or other appropriate measures may be necessary. In addition, due to the cohesionless nature of the man-placed fill, the stand-up time of the soil face will be relatively short and it is possible that drill holes will cave. The Contractor should be prepared to employ methods to keep the face stable during drilling of the soil nails and shall utilize cased drill holes, for nail installation.

Verification and Proof Testing.
Refer to Special Provision 636 - Soil Nail Wall for testing requirements. In the event that changes to the soil nail wall design are required as a result of failed verification or proof tests, or other problems related to unsatisfactory performance of the soil nail wall, the required design changes shall be made at no additional cost to the Authority.

Existing Conditions.
The Contractor shall take all measures necessary to protect the existing I-195 Overpass Bridge from damage throughout the entire construction operation. The Contractor shall take note that the existing west stub abutment adjacent to the proposed soil nail wall is founded on a spread footing and may require supplemental tie-backs to prevent excessive horizontal and vertical movements. The Contractor shall coordinate the spacing and location of the soil nails to avoid interference with the existing bridge abutment and any supplemental tie-back system that may be required. The design of the soil nail wall system shall account for the stresses applied by the existing bridge footing. Any and all damage to the existing I-195 Overpass Bridge caused by the Contractor's operations shall be repaired at no additional cost to the Authority. It shall be repaired immediately and the bridge shored if needed.

636.07 Method of Measurement

The design of the permanent soil nail wall design shall be measured as one lump sum.

636.08 Basis of Payment

Payment shall include all labor, equipment, materials, and incidentals necessary to provide an acceptable permanent soil nail wall design in accordance with the plans and these specifications.

The design of any abutment tie-back anchorage system that may be required shall be incidental to this item.

There will be no additional compensation for design modifications as a result of failed verification or proof tests, or otherwise unsatisfactory performance of the soil nail wall.

Payment will be made under:

Pay Item		Pay Unit
636.400	Soil Nail Wall Design	Lump Sum

SPECIAL PROVISION

SECTION 636

SOIL NAIL CONSTRUCTION MONITORING – EXISTING BRIDGE

636.01 Description

The work covered under this item is for monitoring the proposed soil nail wall and the adjacent west abutment of the existing I-195 Overpass Bridge, which includes, but is not limited to, preconstruction survey reports, surveying, furnishing, installing, protecting, reading, reporting and maintaining instrumentation as part of a Construction Monitoring Program required throughout the project.

A. Purpose of Construction Monitoring: The Preconstruction Survey Reports are required to establish the condition of the existing structure prior to construction activities, and the monitoring is required for evaluation of ground and structure movements during various stages of construction. This item shall be completed separately and independent from other monitoring that may be required as part of the project.

B. Scope of Work: Work associated with the Construction Monitoring shall include, but not necessarily be limited to providing:

1. Preconstruction Survey Reports of existing structures documenting plumbness, levelness, etc. including photographs and/or video documentation of cracks, spalls, and other relevant defects, signed and sealed by a Professional Engineer licensed in the State of Maine.

2. Layout and subsequent verification of all instrument locations and elevations.

3. Access as necessary for the Resident to inspect the instruments to obtain confirmation readings.

4. Replacement of failed equipment at no additional cost to the Authority.

5. Taking immediate remedial action when the response limit is reached as detected by survey from the Deformation Monitoring Points or readings from Tiltmeters; meeting with the Resident to review current field conditions and further steps to be taken as necessary before the recorded movement exceeds the limits value (see Table 1).

6. Temporary monuments and benchmarks.

7. Protection and security for all surface components of the construction monitoring system that are to be maintained.

8. Removal and final disposal of all components of the construction monitoring system, as specified herein, or as directed by the Resident.

9. Construction Monitoring of individual Deformation Monitoring Points shall continue to be performed at the scheduled minimum intervals as defined in these specifications until such time as that particular monitoring point no longer requires monitoring, solely as determined by the Resident.

10. Survey personnel for this work shall be a Professional Land Surveyor licensed in the State of Maine.

636.02 Materials

Materials and products shall be in accordance with the following:

A. Deformation Monitoring Points (DMPs): These are to be used as targets in monitoring horizontal and vertical movement by conventional survey methods from a fixed survey baseline established and maintained by the Contractor and shall have the following features:

1. The target shall be the head of a stainless or galvanized steel bolt welded to a steel angle of ½" minimum thickness fitted to the existing structure's abutments and wingwalls using expansion anchors. It shall also have an indent in the center of its head to receive a surveyor's plumb bob.

2. The target shall be clearly identified using fluorescent spray paint adjacent to the target on the steel angle, and labeled with a unique identification number using a paint stick or similar permanent marker for each DMP.

B. Tiltmeters: These are used to measure plumbness of the vertical face of the existing bridge abutment and shall have the following features:

1. Uniaxial tiltmeter intended to be mounted to exterior of a structure.
2. Mounting bracket and anchor.
3. Compatible readout box, data logger, and wireless connection as required.
4. Minimum Range: +/-5 degrees.
5. Maximum Resolution: 0.003 degrees (10 seconds of arc).

636.03 Construction Methods

A. Instrumentation Layout: Note the following:

1. The DMPs and Tiltmeters required and their approximate locations are to be as shown on the Plans, or as directed by the Resident.

2. The Resident reserves the right to modify the DMP layout as is deemed necessary to monitor the impact of a Contractor proposed method of construction that has been approved. The DMPs and Tiltmeters shall be arranged so that monitoring can continue until completion without interruption. Adequate access for maintenance and reading of the DMPs and Tiltmeters shall be provided.

B. Preconstruction Submittals: These shall be made at least 30 calendar days prior to the commencement of any staged excavation, installation of temporary/permanent sheet pile and/or installation of any soil nail. The required submittals include, but are not limited to, the following:

1. Preconstruction Survey Reports as previously described.

2. Written description of the construction monitoring program, Working Drawings of DMP and Tiltmeter location layout, and details showing all components of the construction monitoring system.

C. Submittals During and After Installations: These shall be made as follows:

1. Submit, within 24 hours of completion of DMP and Tiltmeter installation, initial readings and monitoring data taken immediately after installation to the Resident.

D. General Installation Requirements: The construction monitoring program, prepared by the Contractor for review and approval by the Resident, and the implementation of this program by the Contractor shall conform to the requirements, which include, but are not necessarily limited to the following:

1. All DMPs and Tiltmeters shall be installed in the presence of the Resident.

2. All DMPs and Tiltmeters shall be securely fixed at the approved locations and position, so that the instruments are capable of resisting disturbance from vandalism.

3. Tolerances:

   a. Establish the initial coordinates of each instrument installation to 1/8” or less.

   b. Establish the initial elevation of DMPs and Tiltmeters to 1/8”.

4. The performance and the extent of supplemental monitoring is at the discretion of the Resident. The supplemental monitoring performed by the Resident does not relieve the Contractor of the responsibility for the instrumentation and monitoring activities described in these Special Provisions.

5. The Contractor may install, monitor and interpret data from instrumentation that the Contractor deems necessary to ensure the safety of personnel and the work at no additional cost to the Authority. In the event the Contractor installs instrumentation in addition to that required herein, the Contractor shall:

   a. Coordinate with the Resident to ensure compatibility of collected data.

   b. Implement recommendations developed from interpretations of monitoring program data.

E. Contractor's Responsibilities:

1. The Contractor shall furnish and install components of instrumentation that are to be used during construction. The Contractor shall protect and maintain installed instruments and replace or repair damaged instruments.

2. Disclosure of Instrumentation Data:

   a. Do not disclose instrumentation monitoring data to third parties and do not publish instrument monitoring data without the prior approval of the Resident.

3. Determine exact location of the DMPs and Tiltmeters to be installed in the field with approval of the Resident.

4. Access to DMPs and Tiltmeters: Provide and facilitate access to each DMP and Tiltmeter for the Resident at all times.

F. Monitoring Schedule:

1. All equipment and installation accessories required for operating the instrumentation system and recording of measurements shall be supplied by the Contractor and shall be available at least 4 weeks in advance of construction of an area in which they are to be installed and shall be securely stored where they will not suffer physical damage or damage arising from excessive moisture, extremes of temperature or other adverse conditions.

2. Contractor shall provide and maintain adequate lighting, and provide a safe means of access to all DMPs and Tiltmeters to allow installation, repair/replacement of instruments by the Contractor, and reading of instruments at times selected by the Resident.

3. All deformation monitoring points and Tiltmeters located on the existing bridge substructure shall be installed and initial readings completed a minimum of two weeks prior to any construction activity related to construction and groundwater control. At least four readings shall be obtained prior to the start of construction activities to establish potential background movement due to forces not related to construction (e.g. movement due to temperature).

4. Deformation points and Tiltmeters shall be monitored in accordance to the following schedule of minimum intervals, or as directed by the Resident:

   a. Weekly when certain construction activities (e.g. staged excavation or installing soil nails) are performed at a distance greater than 100 feet from a monitoring point.

   b. Daily when certain construction activities (e.g. staged excavation or installing soil nails) are performed at a distance less than 100 feet and greater than 30 feet from a monitoring point.

   c. Before and after each soil nail is installed less than 30 feet from a monitoring point.

5. If, in the opinion of the Resident, there appears to be excessive movement, the monitoring points shall be surveyed as often as deemed necessary by the Resident.

6. Final survey of the monitoring points shall be completed within 30 to 60 days of wall completion.

G. Deformation Monitoring Points: The DMPs are to be installed and monitored by survey methods for detecting movements of selected fixed points. The work shall also meet the following requirements:

1. Install and monitor a minimum of 22 DMPs as follows:

   At abutment face (4 total):
   3 DMPs 6 inches below the bridge seat as follows: at the center girder for the WB roadway, at the center girder for the EB roadway, and at the middle of the abutment.
   1 DMP 6 inches below the top of the median backwall directly above the lower DMP at the middle of the abutment.

   At each wingwall section (4 total; 2 per wingwall):
   1 DMP 6 inches below the top of the wingwall.
   1 DMP 6 inches above finished grade directly below the upper DMP.

   At Soil Nail Wall (14 total)
   7 DMPs along the soil nail wall alignment 6 inches below the top of wall and spaced at a maximum lateral interval of 20 feet on the initial shotcrete face and relocated to the final CIP face. These DMPs shall be centered about the I-195 baseline with the center DMP coinciding with the I-195 baseline.
   7 DMPs along the soil nail wall alignment 6 inches above proposed barrier and spaced at a maximum lateral interval of 20 feet on the initial shotcrete face and relocated to the final CIP face. These DMPs shall be directly below the upper soil nail wall DMPs.

2. Monitor the elevation to an accuracy of 1/8 inch (95% level of confidence) at each DMP designated to be monitored by the Contractor.

3. Install and monitor a minimum of two Tiltmeters on the backwall of the west abutment as follows:
   1 Tiltmeter 6 to 12 inches above the bridge seat 2 feet north of the center girder for the WB roadway
   1 Titlmeter 6 to 12 inches above the bridge seat 2 feet south of the center girder for the EB roadway

H. Instrument Reading and Records:

1. DMPs shall be surveyed as soon as possible after installation to establish datum readings which shall be established from a minimum of two independent reading operations giving consistent results.

I. Justify Response and Limiting Readings from Instrumentation: The Contractor shall respond to the monitored readings from instrumentation as follows:

1. Implement remedial action if instrumentation readings approach the Limiting Values shown in Table 1.

TABLE 1 – LIMITING INSTRUMENTATION READINGS	
INSTRUMENT	LIMITING VALUE
Abutment and Wingwall DMPs	3/8"
Soil Nail Wall DMPs	3/8"
Tiltmeter	0.05 degrees

2. Take all necessary steps so that the limiting value is not exceeded. Response Values set to be 50 percent of the values shown on Table 1 shall be used to trigger a review of the construction methods and to revise as appropriate to ensure that the limiting values are not exceeded. The Contractor may be directed to suspend activities in the affected areas with the exception of those actions necessary to avoid exceeding the limiting value.

3. If the Response Value is reached, the Contractor shall:

   a. Meet with the Resident to discuss response actions.

   b. Implement the reviewed plan of action, which includes, but is not limited to, limiting the time a staged excavation cut is left unsupported prior to soil nail installation and/or using temporary stabilizing berms during soil nail installation while increasing the frequency of monitoring on adjacent structures.

J. Damage to Instrumentation:

1. The Contractor shall protect all DMPs and Tiltmeters and appurtenant fixtures and other components of instrumentation systems from damage due to construction operations, weather, traffic and vandalism.

2. If a DMP or Tiltmeter is damaged or unusable, the Contractors' instrumentation personnel shall replace the damaged DMP within 72 hours, at no additional cost to the Authority. The Resident will be the sole judge of work stoppage in the vicinity of the damaged or unusable DMP or Tiltmeter until it is again operational, at no additional cost to the Authority.

636.04 Method of Measurement

The work covered under this item shall be on lump sum basis and will not be measured for payment.

636.05 Basis of Payment

Payment for this work shall be compensation for preconstruction survey reports, furnishing, maintaining and installing equipment, materials; installation of instruments; surveying deformation monitoring points; monitoring; and survey data including all tools, labor, and incidentals thereto.

Payment will be made under:

Pay Item		Pay Unit
636.401	Soil Nail Wall Construction Monitoring - Existing Bridge	Lump Sum

SPECIAL PROVISION

SECTION 636

SOIL NAIL WALL

636.01 Description

The Work shall consist of constructing a permanent soil nail retaining wall as specified herein and as shown on the Drawings. The Contractor shall furnish all labor materials and equipment required for completing the Work. The Contractor shall select the method of excavation, drilling method and equipment, final drillhole diameter, and grouting procedures to meet the performance requirements specified herein.

The Work shall include excavating in accordance with the staged lifts specified in the Soil Nail Wall Design; drilling soil nail holes to minimum length and orientation specified in the Soil Nail Wall Design; providing, placing and grouting the encapsulated epoxy coated bars (nails) in the drillholes; placing drainage elements; placing shotcrete reinforcement; applying shotcrete facing over the reinforcement; attaching bearing plates and nuts; performing nail testing. Shotcrete facing construction and placing drainage elements are covered under this Special Provision. Cast-in-place concrete facing construction, construction of the cast-in-place single slope barrier, chain link fencing, and reconstruction of portions of the concrete slope protection is covered by the Standard Specifications. The soil nails will be installed under overhead limitations and will require special care and effort in the vicinity of the existing I-195 bridge abutment. Instrumentation of the soil nail wall and the existing bridge substructure is covered by the "Soil Nail Construction Monitoring – Existing Bridge" Special Provision.

The term "Soil Nail" as used in these Specifications is intended as a generic term and refers to a reinforcing bar grouted into a drilled hole installed in any type of ground.

The term "Layout Drawings" as used in these Specifications shall refer to the plans, profile and typical cross-sections shown on the Drawings. "Layout Drawings" are one form of "Plans" as defined in Section 101.2.

The term "Soil Nail Wall Design" as used in these Specifications shall refer to design information (including drawings, working drawings, shop drawings, sketches, calculations, tables, catalog cuts, or other relevant information) provided to fulfill the requirements of Special Provision 636 Design of Soil Nail Wall, and approved by the Resident.

636.02 Soil Nail and Shotcrete Contractor's Experience Requirements and Submittals

The soil nailing Contractor shall submit a project reference list verifying the successful construction completion of at least 3 permanent soil nail retaining wall or reinforced slope projects during the past 3 years totaling at least 1200 square yards of wall face area and at least 500 permanent soil nails. A brief description of each project with the Owner's name and current phone number shall be included.

A Professional Engineer, registered in the state of Maine, employed by the soil nailing Contractor and having experience in the construction of permanent soil nail retaining walls on at least 3 complete projects over the past 3 years shall supervise the work.

The on-site supervisor and drill rig operators shall have experience installing permanent soil nails on at least 3 projects over the past 3 years. The Contractor shall not use a manufacturer's representatives to satisfy the requirements of this section.

The Contractor's workers installing the shotcrete, including foremen, nozzlemen, and delivery equipment operators, shall be fully experienced to perform the work. All shotcrete nozzlemen on this project shall have experience on at least 3 projects in the past 3 years in soil nail wall shotcrete application work and shall demonstrate ability to satisfactorily place the shotcrete.

Initial qualification of nozzlemen will be based either on previous ACI certification or satisfactory completion of preconstruction test panels. The requirement for nozzlemen to shoot preconstruction qualification test panels will be waived for nozzlemen who can submit documented proof they have been certified in accordance with the ACI 506.3R Guide to Certification of Shotcrete Nozzlemen. The Certification shall have been done by a ACI recognized shotcrete testing lab and/or recognized shotcreting consultant and have covered the type of shotcrete to be used (plain wet-mix, plain dry-mix or steel fiber reinforced). All nozzlemen will be required to periodically shoot production test panels during the course of the work at the frequency specified herein.

Notify the Engineer not less than 2 days prior to the shooting of preconstruction test panels to be used to qualify nozzlemen without previous ACI certification. Use the same shotcrete mix and equipment to make qualification test panels as those to be used for the soil nail wall shotcrete facing. Initial qualification of the nozzlemen will be based on a visual inspection of the shotcrete density and void structure and on achieving the specified 3-day and 28-day compressive strength requirements determined from test specimens extracted from the preconstruction test panels.

Preconstruction and production test panels, core extraction and compressive strength testing shall be conducted in accordance with ACI 506.2 and AASHTO T24/ASTM C42, unless otherwise specified herein. Nozzlemen without ACI Certification will be allowed to begin production shooting based on satisfactory completion of the preconstruction test panels and passing 3-day strength test requirements. Continued qualification will be subject to passing the 28-day strength tests and shooting satisfactory during production test panels.

The Contractor shall submit copies of the completed project reference list and a list identifying the soil nail wall design professional engineer, drill rig operators and on-site supervisors assigned to the project, as well as written documentation of the nozzlemen's qualifications, including proof of ACI certification. The personnel list shall contain a summary of each individual's experience and be complete enough for the Resident to determine whether each individual satisfies the required qualification. The Resident will approve or reject the Contractor's qualifications within 15 days after receipt of a complete submission. Work shall not be started nor materials ordered until written approval of the Contractor's qualifications is given.

The Resident may suspend the Work if the Contractor uses non-approved personnel. The Contractor shall be fully liable for additional costs resulting from the suspension of Work and no adjustments in the contract time resulting from the Work suspension shall be allowed.

636.03 Construction Site Survey

The Contractor shall review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, and location of existing structures and above ground facilities.

Existing foundations, utilities and other underground structures referenced on the Layout Drawings are for informational purposes only. The Contractor is responsible for field locating and verifying the location of all existing foundations, utilities and other underground structures prior to starting the Work. Notify the Resident of any utility locations or conditions different from those shown on the Contract Drawings that may require nail relocations or wall design modifications. The Contractor shall maintain uninterrupted service for those structures and utilities designated to remain in service throughout the Work.

Prior to the start of any wall construction activity, the Contractor and Resident shall jointly inspect the site to observe and document the pre-construction condition of all structures, infrastructure, sidewalks, roadways, and all other facilities adjacent to the site. During construction, the Contractor shall observe the conditions above the Soil Nail Wall on a daily basis for signs of ground or structure movements. The Contractor shall immediately notify the Resident if signs of movements such as new cracks in structures, increased size of old cracks or separation of joints in structures, foundations, streets or paved and unpaved surfaces are observed. The Contractor shall provide the Resident with written documentation of the observed conditions within 24 hours. If the Resident determines that corrective actions are required, the Contractor shall stop work and take necessary steps to correct the problem. When due to the Contractor's methods or operations or failure to follow the specified/approved construction sequence, as determined by the Resident, the costs of providing corrective actions will be borne by the Contractor.

Preconstruction survey reporting and construction monitoring of the wall and existing bridge abutment shall be in accordance with the "Soil Nail Construction Monitoring – Existing Bridge" Special Provision.

636.04 Submittals

The Contractor shall provide the following submittals to the Resident for review and approval. The Contractor will not be allowed to begin soil nail wall construction until all submittal requirements are satisfied and found to be acceptable to the Resident. Changes or deviations from the approved submittals must be re-submitted for approval. No adjustments in contract time will be allowed due to incomplete submittals.

At least 30 days prior to initiating the Work, the Contractor shall submit to the Resident:

1. Details of the equipment and procedures the Contractor proposes to use for grouting permanent soil nails, including regrouting, methods of controlling ground water, and proposed drillhole diameter to achieve the pullout resistance used for design and any variation of these along the alignment.

2. Written documentation of Contractor's qualifications as required under this special provision.

3. Applicable literature from the manufacturer describing equipment proposed to pump soil nail grout into drill holes.

4. Applicable literature from the soil nail assembly manufacturer showing the details of construction, recommended installation procedures, yield and ultimate strength of steel and the minimum cross sectional area.

5. Literature and details describing the specified factory applied "corrosion protection" for the permanent soil nail assemblies.

6. Proposed detailed installation procedures for permanent soil nails indicating proposed equipment and methods to be used for drilling, controlling water pressures, installing, grouting, and testing soil nails.

7. Details of each drillhole size, bar size, cement grout mix design combination on which performance tests will be conducted.

8. Applicable manufacturer's literature on the epoxy coating and encapsulation for the nail bar and the epoxy coating for the anchor head assembly.

9. A detailed construction sequence, planned start of work date, and schedule for completing construction.

10. Methods of excavating the staged lifts and proposed type of excavation equipment.

11. Details of the Contractor's proposed nail grout mix design to be used for grouting of permanent soil nails, which shall include:

    a. Brand and type of Portland cement.
    b. Source, gradation, and quality of all aggregates.
    c. Proportions of mix by weight and water-cement ratio.
    d. Manufacturer, brand name and technical literature of all admixtures (where allowed).
    e. Compressive strength test results (per ASTM C109) verifying the specified minimum 3 and 28 day grout compressive strengths. Previous test results for the same grout mix completed within one year of the start of work may be submitted for initial verification and acceptance of the required compressive strengths and start of production work.

Alternatively, for bagged products, include:

    a. Written certification that the bagged product meets the requirements specified herein.
    b. Manufacturer's quality control tests.

12. Soil nail testing methods and equipment including:

    a. Details of the jacking frame and appurtenant bracing.

b. Details showing methods of isolating test nails during shotcrete application (i.e., methods to prevent bonding of the soil nail bar and the shotcrete facing during testing).
c. Details showing methods of providing the temporary unbonded length and of grouting the temporary unbonded length of test nails after completion of testing.
d. Equipment list.

13. Identification number and certified calibration records for each test jack and pressure gauge and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, device identification number, and the calibration test results and shall be certified for an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.

14. Certified mill test results for nail bars from each type specifying the ultimate strength, yield strength, elongation, composition, and the minimum cross sectional area.

15. Manufacturer certifications for the soil nail centralizers, epoxy coating and encapsulation.

16. A detailed construction drainage control plan addressing all elements necessary to divert, control and dispose of surface water.

17. A detailed action plan for controlling groundwater seepage from the excavation face, mitigating raveling soils, and preventing damage to the soil nail wall.

18. A detailed description of the Contractor's proposed sequence of operations and any other precautions that will be taken to ensure that the various required minimum anchor lengths and sizes are installed at the locations indicated on the drawings.

19. Proposed method of shotcrete placement.

20. Certified shotcrete mix design including:

    a. Brand and type of Portland cement used.
    b. Source, gradation and quality of aggregates as specified herein.
    c. Proportions of mix by weight and water-cement ratio.
    d. Proposed admixtures, manufacturer, dosage, technical literature.
    e. Previous strength test results for the proposed shotcrete mix completed within one year of the start of shotcreting may be submitted for initial verification of the required compressive strengths at the start of production work.

21. Certified mill tests for all reinforcing steel specifying the minimum ultimate strength, yield strength, elongation and composition.

22. Complete data for the drainage geotextile and geocomposite drain strip including manufacturer's certificate of compliance, and installation instructions.

23. Certifications of Compliance for bearing plates, nuts, curing compounds (if used), drainage aggregate and PVC drain piping.

24. Methods of controlling location of front face and determining shotcrete thickness.

25. Proposed detailed installation procedures for steel reinforcement, including method to be used to support steel reinforcement.

26. Proposed methods to be used for temporary dewatering which shall include arrangements, locations and depths of the proposed systems, a complete description of equipment and materials to be used and the procedures to be followed in the installation, operation and maintenance in relation to the proposed sequence of excavation and the proposed locations of points of discharge of water and their relationships to sedimentation control and groundwater treatment systems.

27. Manufacturer's information for the equipment to be used to conduct verification and proof tests on the soil nails. Submit diagram(s) showing the geometry of verification and proof test equipment relative to permanent steel reinforcement bar, end hardware, load cell, method of locking off and adjusting specified load and calibration data for the system of jack and permanent gauges, including a diagram of the Contractor's proposed test equipment setup(s) for monitoring elongation of the bars during verification and proof tests on permanent soil nails.

28. Details on temporary shotcrete facing including materials, methods and control procedures for this work.

29. Details of methods to be used to install temporary casing to prevent any reaction between the casing and the grouted bond length of the nail and/or stressing length during nail testing.

30. Formwork design calculations and details for casting the cast-in-place facing and barrier, prepared by a Licensed Professional Engineer in the State of Maine.

636.05 Pre-Construction Meeting

A pre-construction meeting shall be held prior to the start of wall of the Work and shall be attended by the Resident or the Authority's duly authorized representative, the Contractor, the Soil Nail Wall designer and all Subcontractors involved in the construction of the soil nail wall. Attendance is mandatory. The pre-construction meeting shall be conducted to clarify the construction requirements for the Work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the Contractor and the various Subcontractors - particularly those pertaining to wall excavation, nail installation and testing, excavation and wall alignment survey control, shotcrete, and CIP facing construction.

636.06 Materials

Materials for construction of the soil nail wall shall be furnished new and without defects. The Contractor at no additional cost shall remove defective material from the job site to the Authority. Materials for soil nail structures shall consist of the following:

1. Solid Bar Nail Tendons: Tendons shall meet the requirements of AASHTO M31/ASTM A615 for Grade 60 or 75 steel bars. The deformed bar shall be continuous without splices or welds, new, straight, undamaged, encapsulated epoxy coated and of the size and type indicated in the approve Contractor design. Threading shall be continuous spiral deformed ribbing provided by the bar deformations (e.g. continuous threadbars).

2. Fusion-Bonded Epoxy Coating: Fusion-bonded epoxy coating shall meet the requirements of ASTM A775 and have a minimum thickness of 12 mils up to a maximum of 17 mils applied electrostatically. Bend test requirements shall be waived. The coating at the wall anchorage end of epoxy-coated bars may be omitted over the length provided for threading the nut against the bearing plate.

3. Encapsulation: Bar encapsulation shall be a minimum 40 mils thick corrugated HDPE tube conforming to AASHTO M252 or corrugated PVC tube conforming to ASTM D1784, Class 13464-B. Encapsulation shall provide at least 0.2 inch of grout cover over the nail bar and be resistant to ultra violet light degradation, normal handling stresses, and grouting pressures. Encapsulation shall be factory fabricated.

4. Centralizers: Centralizers are required and shall be manufactured from Schedule 40 PVC, or other material not detrimental to the soil nail steel bar (wood shall not be used). Centralizers shall be securely attached to the tendon and shall be sized to allow: (i) positioning of the soil nail bar within 1 inch of the center of the drill hole; (ii) tremie pipe insertion to the bottom of the drill hole; and (iii) grout to freely flow up the drill hole.

5. Nail Grout: Grout shall be neat cement or sand/cement mixture with a minimum 3-day compressive strength of 1,500 psi and a minimum 28-day compressive strength of 3,000 psi, meeting the requirements of AASHTO T106/ASTM C109.

6. Admixtures for Nail Grout: If admixtures are used, they shall meet the requirements of AASHTO M194/ASTM C494. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to review and acceptance by the Resident. Accelerators shall not be permitted. Expansive admixtures shall not be permitted except where the grout is used as part of corrosion protecting encapsulation.

7. Cement for Nail Grout: AASHTO M85/ASTM C150, Types I, II, III, or V

8. Fine Aggregate: AASHTO M6/ASTM C33

9. Film Protection: Polyethylene film per AASHTO M171

10. Shotcrete: All materials for shotcrete shall conform to the following requirements:

a. Cement	AASHTO M85/ASTM C150, Type I, II, III, or V.
b. Fine Aggregate	AASHTO M6/ASTM C33, clean, natural.
c. Coarse Aggregate	AASHTO M80, Class B for quality.
d. Water	Clean and Potable. AASHTO M157/ASTM C94.
e. Chemical Admixtures	
1. Accelerator	Fluid type, applied at nozzle, meeting requirements of AASHTO M194/ASTM C494/ASTM C1141.
2. Water Reducer and Superplasticizer	AASHTO M194/ASTM C494 Type A, C, D, E, F, or G.
3. Retarders	AASHTO M194/ASTM C494 Type B or D.
f. Mineral Admixtures	
1. Fly Ash	AASHTO M295/ASTM C618 Type F or C, cement.
2. Silica Fume	ASTM C1240, 90 percent minimum silicon dioxide solids content, not to exceed 12 percent by weight of cement. In addition, silica fume shall conform to the requirements of Section 502.
g. Welded Wire Fabric	AASHTO M55/ASTM A185 or ASTM A497.
h. Reinforcing Bars	AASHTO M31/ASTM A615, Grade 60, deformed. Epoxy Coating shall conform to the requirements of Section 503.051.
i. Bearing Plates	AASHTO M183/ASTM A36.
j. Shear Connectors	ASTM A108.
k. Nuts	AASHTO M291, Grade B, hexagonal fitted with beveled washer or spherical seat to provide uniform bearing.
l. Curing Compounds	AASHTO M148, Type 1D or Type 2.
m. Prepackaged Shotcrete	ASTM C928.

10.1 – Shotcrete Mix Design. The Contractor must receive notification from the Resident that the proposed mix design and method of placement are acceptable before shotcrete placement can begin.

10.2 – Aggregate. Aggregate for shotcrete shall meet the strength and durability requirements of AASHTO M6/M80 and shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
12 mm (1/2 inch)	100
10 mm (3/8 inch)	90-100
5 mm (No. 4)	70-85
2.5 mm (No. 8)	50-70
1.25 mm (No. 16)	35-55
0.630 mm (No. 30)	20-35
0.300 mm (No. 50)	8-20
0.160 mm (No. 100)	2-10

10.3 – Proportioning and Use of Admixtures. Proportion the shotcrete to be pumpable with the concrete pump furnished for the work, with a cementing materials content of at least 25 pounds per cubic foot and water/cement ratio not greater than 0.50. Do not use admixtures unless approved by the Resident. Thoroughly mix admixtures into the shotcrete at the rate specified by the manufacturer. Accelerators (if used) shall be compatible with the cement used, be non-corrosive to steel and not promote other detrimental effects such as cracking or excessive shrinkage. The maximum allowable chloride ion content of all ingredients shall not exceed 0.10% when tested to AASHTO T260.

10.4 – Air Entrainment. Air entrainment is not required for temporary shotcrete construction facings.

10.5 – Strength Requirements. Provide a shotcrete mix capable of attaining 2000 psi compressive strength in 3 days and 4000 psi in 28 days. The average compressive strength of each set of three test cores extracted from test panels or wall face must equal or exceed 85 percent of the specified compressive strength, with no individual core less than 75 percent of the specified compressive strength, in accordance with ACI 506.2.

10.6 – Mixing and Batching. Aggregate and cement may be batched by weight or by volume in accordance with the requirements of ASTM C94 or AASHTO M241/ASTM C685. Mixing equipment shall thoroughly blend the materials in sufficient quantity to maintain placing continuity. Ready mix shotcrete shall comply with AASHTO M157. Shotcrete shall be batched, delivered, and placed within 90 minutes of mixing. The use of retarding admixtures may extend application time beyond 90 minutes if approved by the Engineer.

Premixed and packaged shotcrete mix may be provided for on-site mixing. The packages shall contain materials conforming to the Materials section of this specification. Placing time limit after mixing shall be per the manufacturer's recommendations.

10.7 – Field Quality Control. Both preconstruction test panels (for nozzlemen without previous ACI certification) and production test panels or test cores from the wall facing are required. Shotcreting and coring of test panels shall be performed by qualified personnel in

the presence of the Resident. The Contractor shall provide equipment, materials, and personnel as necessary to obtain shotcrete cores for testing including construction of test panel boxes, field curing requirements and coring. Compressive strength testing will be performed by the Contractor. Shotcrete final acceptance will be based on the 28-day strength.

Shotcrete production work may commence upon initial approval of the design mix and nozzlemen and continue if the specified strengths are obtained. The shotcrete work by a crew will be suspended if the test results for their work does not satisfy the strength requirements. The Contractor shall change all or some of the following: the mix, the crew, the equipment, or the procedures. Before resuming work, the crew must shoot additional test panels and demonstrate that the shotcrete in the panels satisfies the specified strength requirements. The cost of all work required to obtain satisfactory strength tests will be borne by the Contractor.

10.8 – Preconstruction Test Panels. Each nozzleman without previous ACI certification shall furnish at least two preconstruction test panels for each proposed mixture being considered and for each shooting position to be encountered on the job. Preconstruction test panels shall be made prior to the commencement of production work using the same equipment, materials, mixture proportions and procedures proposed for the job.

Make preconstruction test panels with minimum dimensions of 30 x 30 in. square and at least 4.0 in. thick. Slope the sides of preconstruction and production test panels at 45 degrees over the full panel thickness to release rebound.

10.9 – Production Test Panels. Furnish at least one production test panel or, in lieu of production test panels, six 3 inch diameter cores taken from the shotcrete facing, during the first production application of shotcrete and henceforth for every 600 square yards of shotcrete placed. Cores for testing must be taken from the nozzle and may not be taken from the mixer. Construct the production test panels simultaneously with the shotcrete facing installation at times designated by the Resident. Make production test panels with minimum dimensions of 18in.x18in. square and at least 4 inches thick.

10.10 – Test Panel Curing, Test Specimen Extraction and Testing. Immediately after shooting, field moist cures the test panels by covering and tightly wrapping with a sheet of polyethelene film (material meeting the requirements of ASTM C171) until they are delivered to the testing lab or test specimens are extracted. Do not immerse the test panels in water. Do not further disturb test panels for the first 24 hours after shooting. Provide at least six 3 inch diameter core samples cut from each preconstruction test panel and production test panel. Contractor has the option of extracting test specimens from test panels in the field or transporting to another location for extraction. Keep panels in their forms when transported. Do not take cores from the outer 6 inches of test panels measured in from the top outside edges of the panel form. Trim the ends of the cores to provide test cylinders at least 3 inches long. If the Contractor chooses to take cores from the wall face in lieu of making production test panels, locations will be designated by the Resident. Clearly mark the cores and container to identify the core locations and whether they are for preconstruction or production testing. If for production testing, mark the section of the wall represented by the cores on the cores and container. Immediately wrap cores in wet burlap or material meeting requirements of ASTM C171 and seal in a plastic bag. Deliver cores to the testing lab within 48 hours of shooting the panels. The remainder of the panels will become the property of the Contractor. Upon delivery to the testing lab, samples will be placed in the moist room until the time of

test. When the test length of a core is less than twice the diameter, the correction factors given in AASHTO T24/ASTM C42 will be applied to obtain the compressive strength of individual cores. Three cores will be tested at 3 days and three cores will be tested at 28 days in accordance with AASHTO T24/ASTM C42.

Fill core holes in the wall by dry-packing with non-shrink patching mortar after the holes are cleaned and dampened. Do not fill core holes with shotcrete.

11. Wall Drainage Network: All materials for the wall drainage network shall conform to the following requirements:

a. Drainage Geotextile	Geocomposite Drain Strip Water Flow Rate (ASTM D4716) – Hyd. Grad. of 1.0 – 15 gpm/ft width Water Flow Rate (ASTM D4716) – Hyd. Grad. of 0.1 – 3 gpm/ft width Grab strength (ASTM D4632) - 100 lbs Apparent Opening Size (ASTM D 4751) – No. 100 Sieve
b. Drainage Aggregate	AASHTO M43/ASTM D448 No. 67 with no more than two (2) percent passing the 75 μm (US No. 200) sieve.
c. PVC Connection Pipe, Horizontal Drains and Weep Holes:	
1. Pipe	ASTM D1785 Schedule 40 PVC, solid and perforated wall, cell classification 12454-B or 12354-C, wall thickness SDR 32, with solvent weld or elastomeric gasket joints.
2. Fittings	ASTM D3034, cell classification 12454-B or 12354-C, wall thickness SDR 35, with solvent weld or elastomeric gasket joints.
3. Solvent Cement	ASTM D2564
4. Primer	ASTM F656

636.07 Materials Handling and Storage

Store soil nail cement to prevent moisture degradation and partial hydration. Do not use cement that has become caked or lumpy. Store aggregates so that segregation and inclusion of foreign materials are prevented. Do not use the bottom 6 inches of aggregate piles in contact with the ground.

Store steel reinforcement on supports to keep the steel from contacting the ground. Damage to the nail steel as a result of abrasion, cuts, nicks, welds, and weld splatter shall be cause for rejection by the Resident. Do not ground welding leads to nail bars. Protect nail steel from dirt, rust, and other

deleterious substances prior to installation. Heavy corrosion or pitting of nails shall be cause or rejection by the Resident. Light rust that has not resulted in pitting is acceptable. Place protective wrap over anchorage end of nail bar to which bearing plate and nut will be attached to protect during handling, installation, grouting and shotcreting.

Do not move or transport the encapsulated nails until the encapsulation grout has reached sufficient strength to resist damage during handling. Handle the encapsulated nails in a manner that will prevent large deflections, distortions or damage. Repair the encapsulated nails that are damaged or defective in accordance with the manufacturer's recommendations or remove them from the site.

Handle and store the epoxy coated bars in a way that will prevent them from being damaged beyond what is permitted by ASTM 3963. Repair damaged epoxy coating in accordance with ASTM A775 and the coater's recommendations using an epoxy field repair kit approved by the epoxy manufacturer. Repaired areas shall have a minimum 12 mils coating thickness.

Materials for shotcrete shall be delivered, stored and handled to prevent contamination, segregation, corrosion or damage. Store liquid admixtures to prevent evaporation and freezing.

Drainage geotextile and geocomposite drain strips shall be provided in rolls wrapped with a protective covering and stored in a manner which protects the fabric from mud, dirt, dust, debris, and shotcrete rebound. Protective wrapping shall not be removed until immediately before the geotextile or drain strip is installed. Extended exposure to ultra-violet light shall be avoided. Each roll of geotextile or drain strip in the shipment shall be labelled to identify the production run.

636.08 Construction Requirements

The construction sequence shall be in accordance with the approved submittal, unless otherwise approved by the Resident. No excavations steeper than those specified therein shall be made above or below the soil nail wall without written approval of the Resident.

636.081 Quality of Workmanship

1. The Contractor is responsible for implementing a Quality Assurance Program. Workers, including foreman, nozzleman, and delivery equipment operators, shall be qualified to perform the work. All nozzlemen on this Project shall meet the experience requirements specified herein.

2. A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements after they are covered will be considered an indication of insufficient cover of reinforcement, poor application technique and probable voids. In this case, the application of shotcrete shall be immediately suspended until inspected by the Resident. The Contractor shall implement and complete corrective measures, including removing and replacing deficient material, prior to resuming the shotcrete operations.

3. Inspection of materials, workmanship, finished products, and installation is required.

4. All grout materials and cores of shotcrete wall shall be tested for conformance with the Specifications by an independent AASHTO accredited testing agency at the Contractor’s expense.

5. Damaged areas of fusion bonded epoxy corrosion protection, including exposed cut-off anchor bar ends, shall be cleaned and coated with corrosion protective epoxy in accordance with the bar manufacturer's recommendations.

636.082 Site Drainage Control

Localized areas of perched water may be encountered at the interface of geologic units, or in other areas within the required excavation limits, and should be anticipated. The Contractor will be responsible for preventing and/or controlling seepage from the excavated face, to allow proper installation and cure of the shotcrete. This may require pre-drainage using horizontal drains, vertical well points, large diameter wells or other methods to be selected by the Contractor.

The Contractor shall be responsible for repair of all damage caused by improper dewatering.

The methods of controlling groundwater within the limits of work (both inside and outside the excavation) shall be determined by the Contractor, who shall be solely responsible for the location, arrangement and depth of any system or systems selected to accomplish the work. The construction dewatering system designed and implemented by the Contractor shall be capable of maintaining groundwater levels so as to obtain a satisfactory undisturbed subgrade, and prevent sloughing and raveling of the excavated face. Maintain water levels until, at a minimum, soil nails have been installed and the shotcrete face has obtained the required 28 day strength. If the methods employed have not been adequate and loss of ground beyond proposed shotcrete face occurs, remove disturbed soil as directed by the Resident. The Contractor shall develop a plan of action for backfilling resulting voids beyond the finish face line and shall submit to the Resident such method(s) 24 hours prior to excavating. Any over-excavation beyond the final soil/wall face shall be immediately restored by the Contractor using a method reviewed by the Resident and at no additional cost to the Authority.

The Contractor shall provide positive control and discharge of all surface water encountered during construction to the extent necessary to prevent adverse conditions as determined by the Resident. Damage caused by the failure to control surface water shall be repaired by the Contractor to the Resident's satisfaction at no additional cost to the Authority.

The Contractor shall be responsible for the condition and maintenance of any pipe or conduit used to control surface water during construction. Upon substantial completion of the Work, surface water control pipes or conduits shall be removed from the site. Alternatively, pipes or conduits which are left in place with the approval of the Resident, shall be fully grouted (abandoned) or left in a manner that protects the structure and all adjacent facilities from migration of fines through the pipe or conduit and potential ground loss.

Comply with federal, state and local codes, ordinances and regulations for disposal of discharged water and sediment control. The Contractor shall be responsible for obtaining all required permits.

636.083 Excavation

Coordinate the work and the excavation so the soil nail wall is safely constructed. Perform the wall construction and excavation sequence in accordance with the approved Soil Nail Wall

Design and approved submittals. No excavations steeper than those shown on the approved Soil Nail Wall Design will be made above or below the soil nail wall without written approval of the Resident. The Contractor shall progress the excavation in a manner that will not adversely affect the stability of the excavated face. The excavation sequence shall ensure sufficient stand-up time for the period of time required for soil nail installation, grouting and construction of the initial shotcrete face along the extent of the excavation cut.

Excavation and Wall Alignment Survey Control. The Contractor will be responsible for providing the necessary survey and alignment control during excavation of each lift, locating and drilling each drillhole within the allowable tolerances. The Contractor will be responsible for performing the wall excavation and nail installation in a manner which will allow for construction of the shotcrete facing to the design minimum thickness and such that the finish CIP structural facing can be constructed to the specified minimum thickness and to the line and grade indicated in the Soil Nail Wall Design. Where the as-built location of the front face of the shotcrete exceeds the allowable tolerance from the wall control line shown on the Soil Nail Wall Design, the Contractor will be responsible for determining and bearing the cost of remedial measures necessary to provide proper attachment of nail head bearing plate connections and satisfactory placement of the final facing, as called for on the Soil Nail Wall Design.

General Roadway Excavation. Complete clearing, grubbing, grading and excavation above and behind the wall before commencing wall excavation. Do not over-excavate the original ground behind the wall or at the ends of the wall, beyond the limits shown on the Contract Drawings. Do not perform general roadway excavation that will affect the soil nail wall until wall construction starts. Roadway excavation shall be coordinated with the soil nailing work and the excavation shall proceed from the top down in a horizontal staged excavation lift sequence with the ground level for each lift excavated as illustrated on the approved Soil Nail Wall Design. During excavation, the Contractor shall maintain a working bench of existing soil to serve as a platform for the drilling equipment and a berm against the final wall excavation face. The bench shall be established not more than 3 feet below the row of nails to be installed and shall extend out from the wall face a minimum distance necessary to provide a safe working bench for the drill equipment and workers.

Soil Nail Wall Structure Excavation. Structure excavation in the vicinity of the existing abutment wall face will require special care and effort compared to general earthwork excavation. The excavation pay limits incidental to the Soil Nail Wall are shown on the Contract Drawings.

Excavation to the final wall excavation face shall be performed using procedures that: (1) prevent ground loss, swelling, air slaking, or loosening; (2) minimize degradation of soil bearing support below the overlying portions of the soil nail wall and below the soil nails currently being installed; (3) prevent premature loss of soil moisture at the face; (4) prevent ground freezing; (5) reduce the potential for shotcrete overages; (6) prevent raveling and/or sloughing of soils; and (7) maintain satisfactory control of seepage at the excavated face to allow proper placement of shotcrete. Costs associated with additional thickness of shotcrete or concrete or other remedial measures required due to irregularities in the cut face, excavation overbreak or inadvertent over excavation, shall be borne by the Contractor.

The exposed unsupported final excavation face cut height shall not exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. The Contractor shall complete excavation to the final wall excavation line and application of the shotcrete in the same work shift. Application of the shotcrete may be delayed up to 24 hours if

the Contractor can show that the delay will not adversely affect the excavation face stability. A polyethylene film over the face of the excavation may reduce degradation of the cut face caused by changes in moisture. Damage to existing structures or structures included in the work shall be repaired by the Contractor at no cost to the Authority where approval is granted for the extended face exposure period.

Excavation to the next lift shall not proceed until nail installation, reinforced shotcrete placement, attachment of bearing plates and nuts and nail testing has been completed and accepted in the current lift. Nail grout and shotcrete shall have cured for at least 72 hours before excavating the next underlying lift.

The Contractor shall be responsible for design and installation of temporary lateral support and the slope stability of all temporary cuts. Completed ends of the soil nail wall shall be protected to prevent loss of ground from behind the soil nail wall and/or movement of ground behind the completed soil nail wall.

Notify the Resident immediately if raveling or local instability of the final wall face excavation occurs. Unstable areas shall be temporarily stabilized by means of buttressing the exposed face with an earth berm or other methods. Suspend work in unstable areas until remedial measures are developed.

If the Soil Nail Wall Design requires placement of a stabilizing berm, or if in the opinion of the Contractor or Resident a stabilizing berm is necessary or prudent, then the following three items shall apply:

1. The Contractor shall not excavate any lift to the final wall excavation face prior to installation of nails but shall maintain a stabilizing berm to support the excavation face during nail installation, unless otherwise approved by the Resident. The stabilizing berm is provided to:
   a. minimize degradation of soil bearing support below the overlying portions of the soil nail wall and below the soil nails currently being installed;
   b. prevent premature loss of soil moisture at the face; and
   c. reduce the potential for ground loss and subsequent shotcrete overages.

   Alternative excavation and soil nail installation methods that meet these objectives may be submitted to the Resident for review in accordance with the Submittals section of this Contract.

2. The stabilizing berm shall extend horizontally from the bottom exterior of the overlying shotcrete a minimum distance of 1 foot and shall be cut down from that point at a slope determined to be safe by the Contractor, but not steeper than 1H:1V, unless otherwise approved by the Resident. Following the installation of nails, the stabilized berm shall be excavated to the final wall face and cleaned of all loose materials, mud, shotcrete rebound, and other foreign matter which could prevent or reduce shotcrete bond.

3. The Contractor shall ensure that installed nails are not damaged during excavation of the stabilizing berm. Nails damaged or disturbed during excavation of berm shall be repaired or replaced by the Contractor to the satisfaction of the Resident at no additional cost to the Authority. The stabilizing berm shall not be excavated until the nail grout has aged

for at least 24 hours. Hardened nail grout protruding from the wall excavation more than 2 inches shall be removed in a manner that prevents fracturing the grout at the nail head. Sledge hammer removal of the grout shall not be allowed. The use of hand held rock chippers is acceptable provided their used does not damage or disturb the remaining grout at the nail head, the nail bar, or the surrounding exposed ground.

Wall Discontinuities. The Contractor shall not be permitted to construct the wall in a discontinuous manner. Each row of nails shall be completed and shotcreted before the Contractor may excavate for the next lower row of nails.

Excavation Face Protrusions, Voids or Obstructions. Removal of cobbles, boulders, rubble, or debris which are encountered at the soil face during excavation and which protrude from the soil face shall be the responsibility of the Contractor. The Contractor shall be responsible for constructing the structural shotcrete facing to the specified minimum thickness and to the lines and grades indicated in the plans. The Contractor shall notify the Resident of the proposed method for removal of face protrusions at least 24 hours prior to commencing with excavation for review and approval. Should the removal of face protrusions result in voids beyond the finish shotcrete wall face/soil line, the Contractor shall backfill the voids within the work shift during which the voids were created using methods reviewed and approved by the Resident. Removal of face protrusions and backfilling of voids or over-excavation is considered incidental to the work.

636.084 Nail Installation

Determine the required drillhole diameter(s), drilling method, grout composition and installation method necessary to achieve the nail pullout resistance(s) used for design, in accordance with the nail testing acceptance criteria in the Nail Testing section.

Successful verification tests shall be performed prior to starting installation of production nails. The number and location of required verification tests are specified in the Soil Nail Wall Design. Additional verification tests may be required if the Contractor modifies the installation method from those used during the installation if the approved verification test nails and will be conducted at the Contractor's expense.

Nails shall be installed prior to the application of shotcrete at the locations and to the lengths specified in the Soil Nail Wall Design. The Resident may add, eliminate, or relocate nails to accommodate actual field conditions. Cost adjustments associated with these modifications shall be made in accordance with the Supplemental Specifications of the contract. Design modifications resulting from actions of the Contractor shall be determined by the Resident. The cost of any redesign, additional material and installation modifications shall be borne by the Contractor.

Reinforced shotcrete may be installed prior to installing the soil nails upon written approval from the Resident. The written request to modify the installation sequence should include a proposed construction sequence and calculations demonstrating that the bearing plates are adequate to span the nail hole or block-out.

Where necessary for stability of the slope face, the Contractor shall have the option of placing a sealing layer (flashcoat) of unreinforced shotcrete or steel fiber reinforced shotcrete or of drilling and grouting of nails through a temporary stabilizing berm of soil to protect and stabilize the slope face of the excavation. Cost shall be incidental to the Work.

Drilling. The drill holes for the soil nails shall be made at the locations, orientations, and lengths shown on the Soil Nail Wall Design or as directed by the Resident. Select drilling equipment and methods suitable for the ground conditions described in the geotechnical report and shown in the boring logs. Drill hole diameter shall be selected to provide the minimum specified grout cover over the soil nail tendon and to develop the specified load carrying capacity. A minimum drillhole diameter is specified in the Soil Nail Wall Design. It is the Contractor's responsibility to determine the final drillhole diameter(s) required to provide the design pullout resistance. Use of drilling muds such as bentonite slurry to assist in drill cutting removal is not allowed but air may be used. With the Resident's approval, the Contractor may be allowed to use water or foam flushing upon successful demonstration, at the Contractor's cost, that the installation method still provides adequate nail pullout resistance. The drill holes shall be cased to support the sides of the drill holes. Where hard drilling conditions such as rock, cobbles, boulders, or obstructions are described elsewhere in the contract documents or project Geotechnical Report, percussion or other suitable drilling equipment capable of drilling and maintaining stable drillholes through such materials, will be used.

Immediately suspend or modify drilling operations if ground subsidence is observed, if the soil nail wall is adversely affected, or if adjacent structures are damaged from the drilling operation. The adverse conditions shall be stabilized immediately at no additional cost to the Authority and the Resident shall be notified of such conditions within 24 hours.

Nail Bar Installation. Provide nail bars in accordance with the schedules included in the Soil Nail Wall Design. Provide centralizers sized to position the bar within 1 inch of the center of the drillhole. Position centralizers so their maximum center-to-center spacing does not exceed 10 feet. Also locate centralizers within 1.5 feet from the top and bottom of the drillhole. Securely attach centralizers to the bar so they will not shift during handling or insertion into the drill hole yet will still allow grout tremie pipe insertion to the bottom of drillhole and allow grout to flow freely up the hole.

Inspect each nail bar before installation and repair or replace damaged bars or corrosion protection. Check uncased drill holes for cleanliness prior to insertion of the soil nail bar. Insert nail bars with centralizers into the drill hole to the required length without difficulty and in a way that prevents damage to the drill hole, bar, or corrosion protection. Do not drive or force partially inserted soil nails into the hole. Remove nails which cannot be fully inserted to the design depth and clean the drill hole to allow unobstructed installation.

Nail Installation Tolerances. The soil nails shall not extend beyond the right-of-way or easement limits shown on the Drawings. Bars shall be centered within 1 inch of the center of the drillhole. Individual nails shall be positioned plus or minus 6 inches from the design locations shown in the Soil Nail Wall Design. Location tolerances shall be considered applicable to only one nail and not accumulative over large wall areas. The nail inclination shall be plus or minus 3 degrees of that shown in the Soil Nail Wall Design. Nails which encounter obstructions during drilling shall be relocated by the Soil Nail Wall designer. Soil nails which do not satisfy the specified tolerances due to the Contractor's installation methods shall be replaced to the Resident's satisfaction at no additional cost to the Authority.

636.085 Grouting

Grouting Mix Design. Use a neat cement grout or a sand-cement grout. Submit the proposed nail grout mix design to the Resident for review and approval in accordance with the submittal section. The design mix submittal shall include compressive strength test results verifying that the proposed mix will have a minimum 3-day compressive strength of 1500 psi and minimum 28-day compressive strength of 3000 psi.

Grouting Testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test nails and initial production nails. During production, nail grout shall be tested by the Contractor in accordance with AASHTO T106/ASTM C109 at a frequency at no less than one test for every 50 cubic yards of grout placed or once per week, whichever comes first. Provide grout cube test results to the Resident within 24 hours of testing.

Grouting Equipment. Grout equipment shall produce a uniformly mixed grout free of lumps and undispersed cement, and be capable of continuously agitating the mix. Use a positive displacement grout pump equipped with pressure gauge, which can measure at least twice but no more than three times the intended grout pressure. Size the grouting equipment to enable the entire nail to be grouted in one continuous operation. Place the grout within 60 minutes after mixing or within the time recommended by the admixture manufacturer, if admixtures are used. Grout not placed in the allowed time limit will be rejected.

Grouting Methods. Grout the drill hole after installation of the nail bar. Each drill hole will be grouted within 2 hours of completion of drilling, unless otherwise approved by the Engineer. Inject the grout at the lowest point of each drill hole through a grout tube, casing, hollow-stem auger, or drill rods. Keep the outlet end of the conduit delivering the grout below the surface of the grout as the conduit is withdrawn to prevent the creation of voids. Completely fill the drill hole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test bond length of proof tested production nails. At the Contractor's option, the grout tube may remain in the hole provided it is filled with grout. Grouting before insertion of the nail is allowed, provided the nail bar is immediately inserted through the grout to the specified length without difficulty.

During casing removal for drill holes advanced by either cased or hollow-stem auger methods, maintain sufficient grout level within the casing to offset the external groundwater/soil pressure and prevent hole caving. Maintain grout head or grout pressures sufficient to ensure that the drill hole will be completely filled with grout and to prevent unstable soil or groundwater from contaminating or diluting the grout. Record the grout pressures for soil nails installed using pressure grouting techniques. Control grout pressures to prevent excessive ground heave or fracturing.

If the grouting of any nail is suspended for more than 30 minutes or if the quality of the grout placement results in a nail that does not satisfy the requirements of the Special Provision, then the steel tendon and grout shall be removed from the hole, disposed of, and replace with fresh grout and undamaged steel at no additional cost to the Authority.

636.086 Nail Testing

Perform both verification and proof testing of designated test nails. Perform a minimum of three pre-production verification tests on sacrificial test nails at locations specified in the Soil Nail Wall Design or listed herein. Perform proof tests on a minimum of 5 percent of the production nails at locations selected by the Resident. Required nail test data shall be recorded by the Engineer. Do not perform nail testing until the nail grout and shotcrete facing have cured for at least 72 hours and attained at least their specified 3-day compressive strength. Testing in less than 72 hours will be allowed only if the Contractor submits compressive strength test results, for tests performed by a qualified independent testing lab, verifying that the nail grout and shotcrete mixed being used will provide the specified 3-day compressive strengths in the lesser time.

The Contractor shall not apply loads greater than 90 percent of the yield strength of the tendon for Grade 60 or 75 bars. Preliminary results shall be submitted to the Resident within 24 hours of the test completion. A full report containing test load results shall be submitted to the Resident within 5 working days of the test completion.

Proof Test Nail Unbonded Length: Provide temporary unbonded lengths for each test nail. Isolate the test nail bar from the shotcrete facing and/or the reaction frame used during testing. Isolation of a test nail through the shotcrete facing shall not affect the location of the reinforcing steel under the bearing plate. Accepted proof test nails may be incorporated as production nails provided the temporary test unbonded length is fully grouted subsequent to testing. Submit the proposed test nail isolation methods, methods for providing an unbonded test length and methods for grouting the unbonded length subsequent to testing to the Resident for review and approval in accordance with the Submittals section. When temporary casing of the unbonded length of test nails is provided, install the casing in a way that prevents any reaction between the casing and the grouted bond length of the nail and/or the stressing apparatus.

Testing Equipment. Testing equipment shall include three (3) dial gauges, a dial gauge support, jack and pressure gauge, an electric load cell and a reaction frame. The load cell is required for verification tests only.

A minimum of three (3) dial gauges capable of measuring to 0.001 inch shall be available at the site to measure nail movement. The dial gauges shall have a minimum travel sufficient to allow the test to be performed without re-setting the dial gauge. The dial gauges shall be aligned within 5 degrees of the axis of the nail and shall be supported independent of the jacking set-up and the wall. A hydraulic jack, pressure gauge and pump shall be used to apply and measure the test load. The nail loads during verification tests shall be monitored with both a pressure gauge and electric load cell. The load cell shall be used to maintain constant load hold throughout the creep test during verification testing. The contractor shall provide recent (within 6 months of the start of construction) calibration curves in accordance with the Submittals.

The jack pressure gauge shall be calibrated by an independent testing laboratory as a unit. The pressure gauge shall be graduated in 100 psi increments or less and shall have a range not exceeding twice the anticipated maximum pressure during testing unless approved by the Resident. The ram travel of the jack shall be sufficient to enable the test to be performed without re-setting the jack. The jack shall be capable of applying each test load increment in less than 1 minute.

The jack shall be independently supported and centered over the nail so that the nail does not carry the weight of the jack. The stressing equipment shall be placed over the nail in such a manner that the jack, bearing plates, load cell and stressing anchorage are in alignment. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test will not be required.

The reaction frame shall be sufficiently rigid and of adequate dimension such that excessive deformation of the test apparatus requiring repositioning of any components does not occur during testing. Where the reaction frame bears directly on the shotcrete facing, the reaction frame shall be designed to prevent fracture of the shotcrete and no part of the reaction frame shall bear within 6 inches of the edge of the test nail block-out, unless otherwise approved by the Resident.

Verification Testing of Sacrificial Nails. Verification testing shall be performed prior to installation of production soil nails to confirm the appropriateness of the Contractor's drilling and installation methods, and verify the required soil nail pullout resistance. Verification tests shall be performed on three (3) sacrificial test soil nails within the limits of the Work and at the locations specified in the Soil Nail Wall Design, unless otherwise approved by the Resident

The details of the verification testing arrangement including the method of distributing test load pressures to the excavation surface (reaction frame), test nail bar size, grouted hole diameter and reaction plate dimensioning, shall be developed by the Contractor and submitted to the Resident for approval. Test nails shall be constructed using the same equipment, methods and hole diameter as planned for the production nails. Changes in the drilling or installation method may require additional verification testing as determined by the Resident and shall be provided at no additional cost to the Authority.

Verification test soil nails shall have both bonded and unbonded lengths. Along the unbonded length, the soil nail bar shall not be grouted. The unbonded length of the test soil nails shall be at least 3 feet as measured from the back of the bearing plate to the top of the grout.

Verification tests shall be conducted according to the loading schedule of Table 1. Each load increment shall be held for at least 10 minutes. The Contractor shall record soil nail movements at each load increment and the time intervals shown in the table for each load step. Creep tests shall be performed at 0.75 VTL. The alignment load (AL) should be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the VTL. The dial gauges shall be set to "zero" after applying the alignment load. Following application of the maximum load, the load shall be reduced to the alignment load and the dial gauge readings recorded as the permanent set.

Each load increment shall be held for at least 10 minutes. The Contractor shall monitor the verification test soil nail for creep at the 0.75 VTL load increment by measuring and recording soil nail movement. The load shall be maintained during the creep test within 2 percent of the intended load by use of the load cell. The test results shall be presented for the Resident's review and acceptance prior to production. The Resident shall have 10 working days to review the report and based on the results, design modifications may be required.

The bonded length of the soil nail during verification tests ($L_{B\ VT}$) shall be:

For Grade 75 and other mild steel in accordance with ASTM A615, the maximum bond length ($L_{B\ VTmax}$), is defined as:

$$L_{B\,VTmax} = \frac{A_t \cdot f_y \cdot C_{RTY}}{r_{PO}}$$

where:

C_{RTY} = reduction coefficient for mild-grade steel = 0.9
A_t = cross-sectional steel area of the test soil nail in square inches
f_y = nominal yield strength of test soil nail (mild steel) in kips per square inch
r_{PO} = nominal pullout resistance in kips per foot of test soil nail per plans = $\pi \times q_u \times D_{DH}$
q_u = nominal bond strength in kips per square foot
D_{DH} = drill hole diameter in feet

If $L_{B\,VTmax} > 10$ feet, select $L_{B\,VT}$ to be 10 feet $\leq L_{B\,VT} \leq L_{B\,VTmax}$.

If $L_{B\,VTmax} < 10$ feet, to avoid tensile breakage, select $L_{B\,VT} = 10$ feet and increase the test soil nail bar size as needed, and recalculate $L_{B\,VTmax}$ until $L_{B\,VTmax} > 10$ ft.

The maximum (nominal) load during the verification test is defined as the Verification Test Load (VTL) and is calculated as VTL = $L_{B\,VT} \times r_{PO}$

Table 1
VERIFICATION TEST LOADING SCHEDULE

Load	**Hold Time (minutes)[2]**
AL[1]	1
0.13 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.25 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.38 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.50 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.63 VTL	10 (recorded at 1, 2, 4, 5, 10)
0.75 VTL (Creep Test)[3]	60 (recorded at 1, 2, 4, 5, 6, 10, 20, 30, 50, 60)
0.88 VTL	10
1.00 VTL[4]	10
AL	1[5]

[1] AL = alignment load, which is less than or equal to 0.05 VTL.
[2] Soil nail movement shall be measured after each load increment has been achieved and at each time step.
[3] Maintain the load during the creep test within 2 percent of the intended load by use of the load cell.
[4] The Engineer may allow loading to failure to determine nominal soil conditions.
[5] Permanent soil nail movement shall also be recorded.

Proof Testing of Production Nails. Successful proof testing shall be performed on 5 percent of the production soil nails in each soil nail row or a minimum of 1 per row. Verification tests shall not be included in the 5 percent; except that the Resident may allow the verification tests to be included based on the plans and site conditions. The Resident will determine the locations and number of proof tests prior to soil nail installation in each row unless otherwise shown on the plans. Production proof test soil nails shall have both bonded and temporary unbonded lengths. Fully grouted test soil nails shall not be proof tested. The Contractor shall maintain the stability of the hole for the temporary unbonded test length for subsequent grouting. If the unbonded test length of production proof test soil nails cannot be satisfactorily grouted subsequent to testing, the proof test soil nail shall become sacrificial and shall be replaced with an additional production soil nail installed at the Contractor's expense. The temporary unbonded length of the test soil nail shall be at least 3 feet as measured from the back of the bearing plate to the top of the grout.

Proof tests shall be conducted according to the loading schedule of Table 2. Unless the soil is susceptible to creep, each load increment shall be held until readings are stable as defined by three readings within 0.005 inches taken one per minute over three minutes. The Contractor shall record soil nail movements at each load increment and the time intervals shown in the table for each load step. Creep tests shall be performed at 1.00 PTL. The alignment load (AL) shall be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the PTL. Set dial gauges to "zero" after applying the alignment load. Following application of the maximum load, reduce the load to the alignment load and record the permanent set.

The creep period shall start as soon as the maximum test load (1.0 PTL) is applied and the soil nail movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. Where the soil nail movement between 1 minute and 10 minutes exceeds 0.04 inch, the maximum test load shall be maintained for an additional 50 minutes and movements recorded at 20 minutes, 30, 50, and 60 minutes. All load increments shall be maintained within 5 percent of the intended load.

The bonded length of the soil nail during proof tests, $L_{B\,PT}$, shall be:

For Grade 75 and other mild steel in accordance with ASTM A615, the maximum bond length ($L_{B\,PTmax}$), is defined as:

$$L_{B\,PTmax} = \frac{A_t \cdot f_y \cdot C_{RTY}}{r_{PO} \cdot 0.75}$$

Select $L_{B\,PT}$ to be 10 ft or $L_{B\,PTmax}$, whichever is smaller, to avoid tensile breakage.

Production proof test soil nails that are shorter than 13 feet may be tested with less than the minimum 10 feet bond length. The maximum load in the proof test (PTL) is calculated as $PTL = L_{B\,PT} \times r_{PO} \times 0.75$

Table 2
PROOF TEST LOADING SCHEDULE

Load	Hold Time (minutes)[2]
AL[1]	1
0.17 PTL	Until Movement Stabilizes[3]
0.33 PTL	Until Movement Stabilizes
0.50 PTL	Until Movement Stabilizes
0.67 PTL	Until Movement Stabilizes
0.83 PTL	Until Movement Stabilizes
1.0 PTL (Creep Test)[4]	10 (recorded at 1, 2, 4, 5, 6, and 10)
AL	1

Notes:
[1] AL = alignment load, which is less than or equal to 0.05 PTL.
[2] Times are measured after the target load has been achieved in each increment.
[3] If the soils reinforced with soil nails are relatively susceptible to deformation of creep, it is recommended to hold each load increment for 10 minutes and to record the soil nail movement at 1, 2, 5, and 10 minutes.
[4] If the soil nail movement measured between 1 and 10 minutes exceeds 0.04 in., PTL must be maintained for 50 additional minutes and movements must be recorded at 20, 30, 50, and 60 minutes. The permanent soil movement must also be recorded.

Test Nail Acceptance Criteria. A test soil nail shall be considered acceptable when the following criteria are met.

1. Verification Testing. The following criteria shall be met for acceptance of the soil nail:

   a. Pullout shall not occur at loads less than 1.00 VTL.

   b. The total movement (Δ_{VTL}) measured at VTL shall exceed 80 percent of the theoretical elastic elongation of the unbonded length (L_{UB}), as defined by:

$$\Delta_{VTL} > 0.8 \frac{VTL \cdot L_{UB}}{E \cdot A_t}$$

   where E = Young's modulus of steel (29,000 ksi).

   c. The creep movement between the 1 and 10 minute readings at 0.75 VTL shall be less than 0.04 in.

   d. The creep movement between the 6 and 60 minute readings at 0.75 VTL shall be less than 0.08 in.

   e. The creep rate shall be linear or decreasing throughout the creep test load-hold period.

2. Proof Testing. The following criteria shall be met to acceptance of the soil nail:

a. No pullout occurs.

b. The total soil nail movement (Δ_{PTL}) measured at PTL shall be greater than 80 percent of the theoretical elastic elongation of the unbonded length, as defined by:

$$\Delta_{PTL} > 0.8 \frac{PTL \cdot L_{UB}}{E \cdot A_t}$$

c. The creep movement shall be less than 0.04 in. between the 1 and 10 minute readings.

d. If this movement is exceeded, PTL shall be maintained for an additional 50 minutes with readings recorded at 20, 30, 50, and 60 minutes.

e. If the creep test is extended, the creep movement between the 6 and 60 minute readings shall be less than 0.08 in.

Test Soil Nail Rejection. If a test soil nail does not satisfy the Test Nail Acceptance Criteria:

Verification test soil nails. The Engineer will evaluate the results of each verification test. The Contractor shall propose and provide plans and calculations for alternative methods for review and acceptance by the Engineer and shall install replacement verification test soil nails. Replacement test soil nails shall be installed and tested at the Contractor's expense. The production soil nails shall be installed using the same installation procedures (drill equipment, drill tooling, drill hole diameter, grouting, etc.) used to provide successful verification tests at no additional cost to the Authority.

Proof test soil nails. The Engineer may require the Contractor to replace some or all of the installed production soil nails between a failed proof test soil nail and the adjacent passing proof test soil nail. Alternatively, the Engineer may require the installation and testing of additional proof test soil nails to verify that adjacent previously installed production soil nails have sufficient load carrying capacity. The Resident may require that modifications be made to the Soil Nail Wall Design by the Soil Nail Wall designer, as appropriate. These modifications may include the installation of additional test and/or production nails (i.e., decreased nail spacing from that specified in the Soil Nail Wall Design), installing longer production nails, increasing the drillhole diameter, or modifying the installation methods. Costs due to additional proof tests or installation of additional or modified nails as a result of proof test nail failure(s) shall be at no cost to the Authority, unless determined by the Resident to be due to causes beyond the Contractor’s control.

636.087 Nail Installation Records

Accurate daily records documenting the Soil Nail Wall construction shall be maintained by the Contractor and provided to the Resident within 24 hours. Daily records shall, as a minimum, include the items listed below:

1. Contractor’s name
2. Drill rig operator’s name
3. As-built, surveyed nail location
4. Deviation from specified tolerances
5. Nail diameter

6. As-built, surveyed nail elevation
7. Design nail length
8. Installed nail length
9. Groundwater conditions
10. Caving or sloughing of excavation
11. Casing requirements
12. Drilling difficulties
13. Date and time of start and finish of drilling
14. Length and diameter of reinforcing bars in hole
15. Date, time, and method grout was placed including grout pressure
16. Total daily quantity of grout placed and quantity per hole
17. Design changes

The Contractor shall assist the Resident as necessary to obtain the above information and all other information as required by the Resident.

636.088 Shotcrete Construction Facing

Shotcrete facing consists of furnishing all materials and labor required for placement of reinforcing steel and shotcrete for the facing and nail head bearing plates and nuts for the soil nail walls shown on the Soil Nail Wall Design. The work shall include any preparatory trimming and cleaning of soil/rock surfaces and shotcrete cold joints to receive new shotcrete.

Shotcrete shall comply with the requirements of ACI 506.2, "Specifications for Materials, Proportioning and Application of Shotcrete", except as otherwise specified. Shotcrete shall consist of an application of one or more layers of concrete conveyed through a hose and pneumatically projected at a high velocity against a prepared surface.

Shotcrete may be produced by either a wet-mix or dry-mix process. The wet-mix process consists of thoroughly mixing all the ingredients except accelerating admixtures, but including the mixing water, introducing the mixture into the delivery equipment, and delivering it, by positive displacement, to the nozzle. The wet-mix shotcrete shall then be air jetted from the nozzle at high velocity onto the surface. The dry-mix process consists of shotcrete without mixing water which is conveyed through the hose pneumatically with the mixing water introduced at the nozzle. For additional descriptive information, the Contractor's attention is directed to the American Concrete Institute ACI 506R "Guide to Shotcrete."

Shotcrete Alignment and Thickness Control. The Contractor shall ensure that the thickness of shotcrete satisfies the minimum requirements of the Soil Nail Wall Design using alignment wires, thickness control pins, or other means acceptable to the Resident. The Contractor shall ensure that the front face of the shotcrete does not extend beyond the tolerance limits shown on the Plans.

Surface Preparation. Prior to shotcreting the ungrounted zone above the nail grout at the excavation cut face (birds beak), the Contractor shall remove all loose materials from the surface of the grout and prepare the joint in accordance with all requirements for joint preparation specified herein.

The Contractor shall remove all loose materials and loose dried shotcrete from previous placement operations from all receiving surfaces to receive shotcrete by methods acceptable to the

Resident. The removal shall be accomplished in such a manner as not to loosen, crack, or shatter the surfaces to receive the shotcrete. Any surface material which, in the opinion of the Resident, is so loosened or damaged shall be removed to a sufficient depth to provide a base that is suitable to receive the shotcrete. Material that loosens as the shotcrete is applied shall be removed. Cost of additional shotcrete is incidental to the work. Divert water flow and remove standing water so that shotcrete placement will not be detrimentally affected by standing water. No shotcrete shall be placed on frozen surfaces.

Delivery and Application. A clean, dry, oil-free supply of compressed air sufficient for maintaining adequate nozzle velocity for all parts of the Work shall be maintained at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly and continuously through the delivery.

The shotcrete shall be applied from the lower part of the Work area upwards to prevent accumulation of rebound on uncovered surfaces. Where shotcrete is used to complete the ungrounted zone of the nail drill hole the face, the nozzle shall be positioned into the mouth of the drillhole to completely fill the void. Rebound shall not be worked back into the placement nor shall the rebound be salvaged. Rebound which does not fall clear of the working area shall be removed. The nozzle shall be held at a distance and at an angle approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized. Thickness, methods of support, air pressure, and rate of placement of shotcrete shall be controlled to prevent sagging or sloughing of freshly-applied shotcrete.

A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements after they are covered will be considered an indication of insufficient cover of reinforcement, poor application technique and probable voids. In this case, the application of shotcrete shall be immediately suspended until inspected by the Resident. The Contractor shall implement and complete corrective measures, including removing and replacing deficient material, prior to resuming the shotcrete operations. The shotcreting procedure may be corrected by adjusting the nozzle distance and orientation, by insuring adequate cover over the reinforcement, by adjusting the water content of the shotcrete mix or other means. Adjustment in water content of wet-mix will require requalifying the shotcrete mix.

Defective Shotcrete. Surface defects shall be repaired as soon as possible after initial placement of shotcrete. All shotcrete which lacks uniformity, which exhibits segregation, sagging, honeycombing, or lamination, or which contains any voids or sand pockets shall be removed and replaced with fresh shotcrete by the Contractor to the satisfaction of the Resident. In-place shotcrete determined not to meet the specified strength requirement will be subject to remediation as determined by the Resident. Possible remediation options include placement of additional shotcrete thickness or removal and replacement, at the Contractor’s cost.

Construction Joints. Construction joints shall be uniformly tapered toward the excavation face over a minimum distance equal to the thickness of the shotcrete layer. Provide a minimum reinforcement overlap at reinforcement splice joints as shown on the Plans. Clean and wet the surface of a joint before adjacent shotcrete is applied. Where shotcrete is used to complete the top ungrouted zone of the nail drill hole near the face, to the maximum extent practical, clean and dampen the upper grout surface to receive shotcrete, similar to a construction joint.

Finish. Shotcrete finish shall be either an undisturbed gun finish as applied from the nozzle or a rough screeded finish. Shotcrete extending into the finish face section beyond the tolerances shown on the Soil Nail Wall Design shall be removed.

Attachment of the Bearing Plate and Nut. The bearing plate and nut shall be attached as shown in the Soil Nail Wall Design. The plate shall be seated by hand wrench tightening the nut such that uniform contact with the shotcrete is achieved while the shotcrete is still plastic and prior to its initial set. Where uniform contact between the plate and the shotcrete cannot be provided, the plate shall be seated on a mortar pad to provide uniform support. Once the mortar pad has attained strength (minimum 1 day), the nut shall be hand wrench tightened. Where studded bearing plates are used to connect the soil nail to the cast-in-place finish facing, the Contractor shall ensure that the bearing plate is in full contact with the construction facing and that the studs are located within the tolerances shown on the Soil Nail Wall Design.

Weather Limitations. Shotcrete shall not be placed in cold weather unless adequately protected when the ambient temperature is below 40ºF and falling and/or when the shotcrete is likely to be subjected to freezing temperatures before a minimum strength of 700 psi. Cold weather protection shall be maintained until the strength of the in-place shotcrete is greater than 750 psi. Cold weather protection shall include heating under tents, blankets or other means acceptable to the Resident. The temperature of the shotcrete, when deposited, shall not be less than 50ºF or more than 90ºF.

Shotcrete application shall also be suspended during high winds and heavy rains when in the opinion of the Resident the quality of the application is not acceptable. Newly placed shotcrete exposed to rain that washes out cement or otherwise makes the shotcrete unacceptable to the Resident shall be removed and replaced. The Contractor shall provide adequately secured polyethylene sheeting or equivalent when adverse exposure to weather is anticipated.

Tolerances. Tolerances for construction facing and temporary shotcrete shall be as shown on the Plans and as required by the Soil Nail Wall Design.

Safety Requirements. Special attention shall be given to eye and dust protection hazards when shotcrete is applied. Cement and other admixtures are caustic and may cause skin and respiratory irritation unless safety measures are takes in addition to required ventilation. Nozzlemen and helpers shall be equipped with gloves, eye protection, and adequate clothing during the application of shotcrete. The Contractor is responsible for meeting all Federal, State and Local Safety Code requirements.

636.089 Wall Drainage Network

The Contractor shall install and secure all elements of the wall drainage network scheduled to be incorporated into a lift as specified by the Soil Nail Wall Design, as specified herein, or as required by the Resident to suit the site conditions. Unanticipated subsurface drainage features exposed in the excavation cut face shall be captured independently of the drainage network and shall be mitigated prior to shotcrete application.

The drainage network shall consist of installing geocomposite drain strips, PVC connection pipes and wall footing drains as shown on the Soil Nail Wall Design or as directed by the Resident.

Exclusive of the wall footing drains, all elements of the drainage network shall be installed prior to shotcreting.

Geocomposite Drain Strips. Geocomposite drain strips shall be installed as specified in the Soil Nail Wall Design. Drain strips at construction joints shall be placed such that the joint is aligned as close as practical along the middle of the longitudinal axis of the drain strip.

The geocomposite drain strips shall be at least 18 inches wide and shall be secured to the excavation face with the geotextile side against the ground after shotcreting. "U" shaped securing pins shall be at least 8 inches long with a 2.5 foot width and shall be installed 24 inches longitudinally along the length of the drain. Drain strips shall be made continuous by using the "shingle" method of splicing with a 16 inch minimum overlap such that the flow of water is not impeded.

The center-to-center spacing of the drain strips shall not exceed 5 ft.

Footing Drains. Footing drains shall consist of drainage aggregate and perforated PVC pipe and shall be constructed at the bottom of each wall as shown on the Layout Drawings.

Connection Pipes and Weepholes. Connection pipes and weepholes shall be installed as shown on the Layout Drawings, and as specified in the Soil Nail Wall Design. Connection pipes shall be lengths of solid PVC pipe installed to direct water from the geocomposite drain strips into the footing drain. Connection pipes and weep holes shall be connected to the drain strips by installing prefabricated drain grates as detailed on the Layout Drawings and specified in the Soil Nail Wall Design, and in accordance with the drain strip manufacturer's recommendations. The joint between the drain grate and the drain strip and the discharge end of the connector pipe shall be sealed to prevent shotcrete intrusion. Damage of the geocomposite drain strip which, in the opinion of the Resident, may cause interruption in flow shall require installation of additional connection pipes or weepholes above the damaged section. Connection pipes shall be extended to the edge of the footing drain but not through the drainage geotextile. The integrity of the drainage geotextile shall not be interrupted.

636.09 Method of Measurement

The unit of measurement for installation of the Soil Nail Wall will be per square foot and includes soil nail installation, placement of shotcrete, drainage elements, Cast-in-place facing, Cast-in-place barrier, chain link fencing, concrete gutter, slope protection replacement, and installation of any abutment tie-back anchorage system that may be required. Measurement will be made on the vertical plane of the front face of the final cast-in-place facing as accepted in the final work.

No specific payment will be made for verification or proof nail testing, which shall be considered incidental to production nail installation. Failed verification test nails or verification test nails installed to verify alternative nail installation methods proposed by the Contractor shall be considered incidental to production nail installation.

The final pay quantity shall be the design quantity increased by any authorized changes, as determined by the Resident.

636.10 Basis of Payment

The accepted quantities of Soil Nail Wall will be paid for at the contract unit prices. The payment shall be full compensation for all labor, equipment, earthwork, materials, material tests, field tests, and incidentals necessary to acceptably fabricate and construct the Soil Nail Wall, including installation of the soil nails, placement of shotcrete, drainage elements, Cast-in-place facing, Cast-in-place barrier, chain link fencing, concrete gutter, slope protection replacement, and installation of any abutment tie-back anchorage system that may be required, in accordance with all requirements of the Contract.

Payment will be made under:

Pay Item		Pay Unit
636.411	Soil Nail Wall	Square Foot

SPECIAL PROVISION

SECTION 639

ENGINEERING FACILITIES

(Instrumentation (Geotechnical))

639.01 Description

This work shall consist of installing settlement platforms, periodic survey of the platforms, reporting the settlement data to the Authority, and removal of the platforms for the Exit 35 south bound on ramp embankment. This work includes but may not be limited to the following: 1) site preparation; 2) furnishing, fabricating, installing, maintaining and protecting settlement platforms and protective barriers; 3) extending settlement platforms/riser piping up through the embankment fill as the fill is placed; 4) periodic surveying of the platforms; 5) reporting the settlement data and 6) removal of the platforms.

MATERIALS

All materials are to be provided by the Contractor unless specifically stated that an item will be provided by the Authority, or the Engineer.

639.02 Settlement Platforms and Protective Barriers

Settlement platforms shall consist of five-foot-long sections of 2-inch diameter black iron pipe, threaded at both ends (one pipe coupling for each length), and attached at the bottom to a 2-foot by 2-foot by 1.5-inch-thick pressure-treated plywood base using a black iron floor flange, as shown on the Plans. A black iron coupling shall be provided at the top of each settlement platform. Settlement platforms which will penetrate through the embankment fill shall be shielded from drag loads caused by compression of the embankment fill by a 4-inch diameter Schedule 40 PVC pipe placed around the black iron settlement platform pipe as shown on the Plans. Protective barriers shall be fabricated from sound lumber or temporary concrete barrier, as shown on the Plans.

CONSTRUCTION REQUIREMENTS

It is of paramount importance on this site that the Contractor protect settlement platforms from damage. Due to the nature of the site and proposed construction, the platforms will be located within the limits of work. Such protective measures may consist of, but are not limited to, the placement of protective barriers around the installations. Caution markings shall be clearly visible from construction equipment.

Prior to the start of site work activities, the Contractor shall submit a plan, at the request of the Resident, detailing the measures to be employed to mark and protect instrumentation. The plan shall identify by list and location sketch all settlement platforms located within the limits of work.

The Contractor shall identify the individual(s) on the Contractor's staff permanently assigned to the job, who is/are competent and may act on behalf of the Contractor, and who will coordinate the settlement platform installation, monitoring, surveying and reporting. Survey shall be completed by a surveyor licensed in the State of Maine.

639.03 Settlement Platforms and Protective Barriers

Settlement platforms and protective barriers shall be furnished, fabricated and installed by the Contractor at the locations shown on the Plans. The Contractor shall provide all labor, equipment and materials necessary to extend the settlement platforms up through the embankment fill as the fill is placed.

The Contractor shall place a 4-inch diameter Schedule 40 PVC pipe around the settlement platform black iron pipe during construction of the preload embankment to protect it against drag forces due to compression of the embankment fill. The PVC pipe shall extend from the top of the plywood base to a level 6 inches below the top of the black iron pipe. The top of the black iron pipe shall always extend above the top of the PVC pipe so that survey measurements can be made by the Contractor.

The Contractor shall construct and maintain barriers around each of the settlement platforms as shown on the Plans to provide protection to the settlement platforms during construction.

639.04 Fill Placement and Compaction Near Instruments

Fill placement and compaction within 3 feet of riser pipes or instruments (in plan) shall be accomplished by hand in a manner approved by the Engineer. Compaction shall be accomplished using approved hand-operated power compactors.

639.05 Platform Monitoring, Data Collection and Data Reporting

The Contractor shall take all necessary precautions to prevent damage, disturbance or movement of the settlement platforms, once installed. The Contractor shall immediately notify the Resident of any instrument damage, disturbance or movement. The Contractor is required to halt all work within a 50-foot radius of a damaged installation, and immediately repair, reset, resurvey, or replace damaged, disturbed or moved monitoring devices as directed by the Engineer. All repair work shall be coordinated with and approved by the Resident and shall also be subject to approval by the Engineer.

Survey personnel for this work shall be a Professional Land Surveyor license in the State of Maine. After installation, the top of the iron pipe shall be surveyed to a horizontal accuracy of 0.1 inch and elevation accuracy of 0.01 inch. Each subsequent settlement reading shall be to a horizontal accuracy of 0.01 inch.

The Contractor shall survey the top of the settlement platforms at the following times:

1. After initial placement of the settlement platforms.

2. Before and after additional sections of riser pipe are added to raise the settlement platforms.
3. Any time that the settlement platforms are disturbed/impacted, damaged, vandalized or otherwise altered.
4. At least daily during placement of fill.
5. At least weekly during after completion of embankment filling.
6. Any other times deemed necessary by the Engineer.

Data collected by the Contractor shall be emailed to the Resident and the Engineer within 48 hours after collection in report form. At a minimum, the report must include:

1. Project Title
2. Date of report
3. Elevation and settlement data presented in tabular form showing all previous readings of the instrument with corresponding dates.
4. Plot of elevation and settlement versus time.

639.06 Anticipated Preload Duration

Completion of the preload period will be determined by the Engineer based on the collection and evaluation of settlement data. The preload duration for the embankment is estimated to be approximately 6 months. The preload duration is measured from the time that fill placement up to the elevations shown on the Plans has been completed. The Contractor shall consider the anticipated durations stated herein in the development of their bid and in the sequencing and scheduling the work.

609.07 Installation Sequence of Instrumentation

The Contractor is advised to review the geotechnical information provided on the plans and this Special Provision for the location and layout information. The following sequence of construction activities is provided for the Contractor's planning purposes. The Contractor shall be advised that the following information is general and may vary.

1. Clear and grub.
2. Place aggregate subbase course - gravel on natural subgrade after grubbing and/or muck excavation followed by the drainage layer.
3. Install settlement platforms on drainage layer.
4. Complete initial survey of settlement platforms.
5. Install prefabricated vertical drains.
6. Extend settlement platforms riser pipes as embankment fill progresses.
7. Complete survey of settlement platforms before and after extending.
8. Continue placing fill until design grades are reached.
9. Install catch basin barrel sections and instruments as denoted in the plans.

639.08 Removal of Settlement Platforms

When directed, the Contractor shall remove settlement platforms and catch basin barrel sections at locations shown in the Plans. After the final elevations have been read, the Contractor shall carefully excavate around the settlement platforms down to three feet below the design subgrade. The steel and PVC pipes shall be removed so they are flush with the bottom of the excavation. The Contractor shall backfill the annular space between the steel and PVC pipes remaining in place, with a uniformly graded sand to within 12 inches of the top. The top 12 inches of the steel pipes and annular space between the steel and PVC pipes shall be sealed with a closed cell, exterior grade, expandable foam.

The excavations shall be backfilled with aggregate subbase coarse gravel (703.06 - Type D) in layers not exceeding eight inches. Each layer shall be compacted to a minimum 95 percent maximum dry density obtained from AASHTO T180.

639.09 Method of Measurement

Instrumentation (geotechnical) provided in accordance with Plans and Special Provision will be measured by the lump sum.

639.10 Basis of Payment

Instrumentation (geotechnical) will be paid for at the Contract lump sum price which shall be full compensation for all labor, materials, and equipment required to install, extend, protect, replace (if necessary), monitor, survey and data reporting the instrumentation and associated items described in this section and shown on the Plans. Removal and replacement of instrumentation damaged by the Contractor shall be incidental to the work.

Payment will be made under:

Pay Item		Pay Unit
639.26	Instrumentation (Geotechnical)	Lump Sum

SPECIAL PROVISION

SECTION 643

TRAFFIC SIGNALS

(Lane Use Signal)

643.01 Description

This work shall consist of the supply and installation of lane use signals (Non-Flashing). All equipment, installation of equipment, and other incidental work shall conform to the latest applicable provisions of: NEC, MUTCD, NESC, NEMA, and the ITE Standards for traffic control equipment. All work shall be done to the satisfaction of the Resident. The meaning of specific terms shall be as defined in MUTCD, NESC, and the ITE Standards for traffic control equipment.

643.02 Materials

The lane use signal heads shall be Signal-Tech DOT2424RG-175 or approved equal. See Appendix J for technical product details.

643.03 Installation

The new lane use signal housing and LED signal shall be installed and wired over the center of the new lane. Pelco (or equal) mounting brackets shall be used and will be incidental to the installation of the new lane use signal. The contractor shall provide a one-year warranty on all material and workmanship related to the installation of the new lane use signal.

643.04 Method of Measurement

Lane use signals will be measured by each unit, installed and accepted.

643.05 Basis of Payment

Lane Use Signals will be paid for at the Contract unit price each which payment shall be full compensation for the furnishing and installation of new lane use signals, and all other materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
643.712	Lane Use Signal	Each

SPECIAL PROVISION

SECTION 643

TRAFFIC SIGNALS

This provision of Section 643 of the 2014 MaineDOT Standard Specifications shall apply with the following additions and modifications:

643.01 Description

This work shall consist of the installation of traffic signals at Maine Turnpike Exit 35 Southbound and Route 112 in Saco, and at North Street, Maine Turnpike Exit 35 Northbound and Lund Rd in Saco. The work shall include new cabinets, mast arms, conduit and all necessary fittings, cables, and components as required to make a fully functional interconnected traffic signal and video detection system.

Traffic signal terms shall be in accordance with those defined in the NEC, MUTCD, NESC, NEMA, IMSA, and the ITE Standards for traffic control equipment.

643.02 General

The following sentence shall be added after the sixth sentence of the second paragraph:

All conduits for conductors shall conform to NEMA or UL standards and listed certification by a Nationally Recognized Testing Laboratory.

643.021 Materials

A list of the recommended materials required to install the system may be included in the plans or as an amendment to this specification, but the Authority will give no guarantee as to the completeness of this list. Unless otherwise specified, all equipment and components shall be new and free of defects.

Electrical materials shall meet the standards herein, local and utility codes, and the National Electrical Code, where applicable.

Drawings, manufacturer's specifications and applicable catalog cuts for all materials and components shall be submitted in accordance with Section 105.7 of the Standard Specification within 21 days after award of the Contract. An additional set of final approved documents, to total 6 sets, shall be provided to the Resident.

At the conclusion of the project, three complete printed sets and one digital set of cabinet prints (24 inch by 36 inch) and one complete set of user manuals will be provided and left in the cabinet. The cabinet prints will be an exact representation of the wiring, including field wiring, and programming that is actually present in at the time of acceptance. This shall also include a laminated 8.5" x 11" chart posted on the door closest to the controller that states at least the following; phasing diagram, intersection sequence, timing chart for both free and all coordination

plans as applicable, and preemption timing, as actually programmed in the controller at the time of acceptance.

643.0211 Traffic Signal Heads

New housings shall be constructed of die cast aluminum or polycarbonate with a smooth outer surface. All housings shall be equipped with a Quick Change Kit as manufactured by GGI Road and Traffic. Housings shall be adaptable for pedestal, bracket, or rigid mast arm vertical or horizontal mounting. The assembled housing shall be dust proof and moisture proof. Each housing shall be equipped with a hinged door of die cast aluminum or polycarbonate to hold the lens and parts of the optical units. The doors shall be designed to ensure uniform pressure around the doorframe when closed. Doors shall be fastened by two hinged wing nut assemblies or other approved fasteners. Unless otherwise indicated on the plans, lenses shall be furnished with approved tunnel visors (not less than 10 inches). If either longer visors than those specified above or louvers are deemed necessary, they shall be furnished and installed at no additional cost to the Authority. If required, louvers shall be attached with a minimum of two (2) stainless steel machine screws, nuts and washers, the use of "self-tapping" machine screws will not be allowed. If louvers are deemed necessary, they shall be attached as described above in 3 locations equidistant around the circumference of the louver.

All traffic signals shall be furnished with a 5-inch backplate with a factory applied 2" diamond grade retroreflective border. Backplates shall be louvered aluminum coated flat black, be fastened with stainless steel hex head slotted screws and a 3/16 inch by 3/4 inch stainless steel fender washer. Signal housings shall be manufactured by the Econolite Group, Inc. or an approved equal.

The assembled housings shall be made up of individual sections fastened together with bolts; the assembly of sectional units shall present a smooth unbroken contour of pleasing appearance. Each end of the housing assembly shall have an opening for a 1-1/2 inch pipe nipple. The area around this opening shall be reinforced and serrated so that lock nuts will seat firmly. The use of "Tri-Studs" to join the signal sections together will not be permitted.

Where five-section "Dog-house" style housings are used, the lower doors shall be arranged so that the doors open in opposite directions of each other, so that any one door can be opened independently of the others. One gasketed cap shall be supplied with each new assembled housing to act as a cover over the hole in the top to prevent water from entering. Signal housing drain holes shall be unobstructed and oriented to drain. Where this is not possible, RTV or other sealant as approved by the resident shall be used to permanently seal the manufacture's drain holes, and new holes field drilled in as close to the same location and size as the manufacture's drain holes as practicably possible.

Housing adapters for pedestal mounting shall be constructed of cast iron. They shall be adjustable with serrated surfaces to permit the housing to be locked in the desired horizontal position. The adapters shall be secured to the bottom of the housing by means of a close nipple, shall slip fit at least 7 inches over a standard traffic signal post of 4 inches in diameter and shall be secured to the post by a minimum of four set screws. The adaptors shall also be equipped with a means to support the top of the signal housing. Adapters shall contain raceways from the housing to the post to protect the wires from the elements.

Mast arm brackets shall be cabled with "Astro-Brac" by Pelco or an approved equal. Tubes for the brackets shall be equipped with a gusset oriented toward the mast arm to facilitate running communication and power cable, this gusset shall be sealed with the manufacturer's supplied sealing membrane, the tube itself shall be held in place by the use of a hinged clamp, Pelco AG-3055 or approved equal. The use of u-bolts will not be permitted.

Span wire hardware shall consist of hangers with a cast nipple. "Tri-Stud" hangers will not be permitted.

Light Emitting Diode (LED) lamps shall have a regulated power supply designed to electrically protect the diodes. The lamp shall be watertight and sealed to eliminate contaminants. The lamp shall be capable of operating at ambient air temperatures of -40° F to 140° F. LED's shall be a 48 Volt DC LED module as manufactured by Leotek or an approved equal. All LED lamps shall have a date code not to exceed 6 months prior to the start of construction.

Each LED module shall be wired with two leads which shall terminate at the terminal block in each signal head. Separate leads shall be used to wire the block to the base. Leads shall be minimum 18 AWG stranded wire with spade-type copper terminal ends. All colors shall be bright and clearly defined and cover the insulation the entire length of the lead. The color of these leads shall be as follows:

(a) From the receptacle behind the red or "Don't Walk" lens: one red wire and one white or black wire with an optional red tracer;
(b) From the receptacle behind the yellow lens: one yellow wire and one white or black wire with an optional yellow tracer;
(c) From the receptacle behind the green or "Walk" lens: one green wire and one white or black wire with an optional green tracer;
(d) From the receptacle behind the green arrow: one blue wire and one white or black wire with an optional blue tracer.

LED lamp life shall be a minimum of 100,000 hours of continuous operation. Power consumption for 12" indications including power supply shall not exceed 10 W.

LED modules shall conform to the standards set forth by the Institute of Transportation Engineers and shall be of the color indicated, circular in shape, with a visible diameter of approximately 12 inches.

643.0212 Pedestrian Signal Heads

Pedestrian signal heads shall be LED type conforming to the Institute of Transportation Engineers Standard for Adjustable Face Pedestrian Signal Heads. The LED aluminum pedestrian signal displays bright and uniform symbol message "HAND" in Portland Orange and "WALK PERSON" in Lunar White. In addition, a countdown timer in Portland Orange LED's will be included. All messages shall be contained in a single section head.

Pedestrian signal housings shall be one-piece die-cast aluminum or polycarbonate complete with top, bottom, sides, and back. For mounting purposes, the top and bottom of the housing shall have openings to accommodate standard 1-1/2 inch pipe brackets. The outside

surface of the openings shall be serrated to provide for positive positioning of the housing. Doors and fasteners shall be as specified in 643.0211. The completed assembly shall be dust and moisture-proof. Each housing shall include a tunnel visor. Housings shall be manufactured by the Econolite Group, Inc. or an approved equal.

Each LED module shall consist of a 16-inch by 18-inch assembly that utilizes LED overlaid filled countdown style with the filled hand/man on the left and the countdown on the right. The countdown module shall only operate in clearance cycle countdown mode. The countdown module will start counting when the flashing clearance signal turns on and will countdown to "0" and turn off when the steady "Don't Walk" signal turns on. The units shall not have any external attachments, dip switches, toggle switches or options that will allow the mode to be changed from counting the clearance cycle, to the full walk/don't walk cycle or any other modification to the icons or digits. The control and regulation module shall be of the "smart" type in order for the countdown displays to be automatically adjusted with the programmed intervals of the traffic controller. At power on, the module enters a single automatic learning cycle. During the automatic learning cycle, the countdown display shall remain dark.

Pedestrian LED modules shall be engineered to fit in all ITE compliant conventional cast aluminum or polycarbonate pedestrian signal housings. Each LED Module shall utilize appropriate technology to achieve the required color and shall be the ultra-bright type rated for 100,000 hours of continuous operation from -40° F to *165*° F (-40°C to +74°C), Each individual LED module shall be wired such that a catastrophic loss or failure of one LED will result in the loss of not more than 5 percent of the signal module light output. The modules shall be rated for a minimum useful life of 48 months. All wiring and terminal blocks must meet the requirements of Section 13.02 of the ITE Publication Equipment and Material Standards, Chapter 2 (Vehicle Traffic Control Signal Heads). LEDs shall be 48 Volt DC as manufactured by Leotek or an approved equal.

Each LED module shall feature two 39-inch long 20 AWG minimum wire lead with strain relief and spade terminals for connection to the terminal block of the signal heads. One of the conductors shall contain white or black insulation to signify neutral or ground. The color of other conductor shall be different and shall be used to differentiate between the "RAISED HAND" and the "WALKING PERSON" LED modules. The two conductors shall be 600 Volt, 20 AWG minimum, jacketed wires conforming to the National Electric Code, rated for service at 220° F. Each LED module shall incorporate a printed circuit board containing all required LEDs and circuit components.

The external lens surface shall be smooth with no raised features, so as to minimize the collection of dirt, debris, and other particulate contaminants, which may impact luminous intensity, and to facilitate periodic cleaning. External lens facets are prohibited. Both the "RAISED HAND," the "WALKING PERSON" and the countdown LED modules shall be filled with LEDs to give the appearance that the entire image is illuminated when energized. Outlined images will not be permitted. The height of the "RAISED HAND" and the "WALKING PERSON" images on the module shall not be less than 10 inches and the width of each image shall not be less than 7 inches. The uniformity ratio of an illuminated symbol shall not exceed 4 to 1 between the highest luminance area and the lowest luminance area in the module.

643.0213 Pedestrian Push Buttons

Pedestrian push buttons shall be of the Accessible Pedestrian Signal (APS) type. The push button station (PBS) shall have push button confirmation, adjustable locator tone, a vibrating button during the "Walk" phase, the ability to play custom messages and shall automatically adjust sound to ambient noise levels. The PBS shall be a 2 Wire with black base and yellow front housing, countdown pedestrian sign (9x15, R10-3e) and saddle, an arrow indicating direction to and parallel with the crosswalk, braille street crossing on the faceplate and custom street crossing message as shown on the plans. PBS to be a Polara iNavigator iN2 or approved equal. PBS will be interfaced through the SDLC bus utilizing an ICCU-S2 and iN2ICB. Any ancillary equipment, such as cabling and rack mounting hardware, shall be included and no separate payment for these items shall be made.

643.03 Traffic Signal Poles, Mast Arms, and Pedestals

Section 720 of the Standard Specifications shall apply unless otherwise noted.

Steel Structures. Sections 720.03 and 720.04 of the 2014 Standard Specifications shall apply.

Concrete foundations shall be concrete Class 'A' meeting the requirements of Section 502 of the 2016 MTA Supplemental Specifications - Structural Concrete. Reinforcing steel shall meet the requirements of Section 503 of the Standard Specifications – Reinforcing Steel. The foundations shall be as shown on the plans.

Anchor bolts. Section 720.07 of the Standard Specifications shall apply. Mast-arm structure and foundation (when required) design calculations and shop drawings shall be submitted for documentation in accordance with Section 105.7 of the Standard Specifications.

Wood Utility Poles. Section 720.10 of the Standard Specifications shall apply. Messenger, tether and guy cable shall be a minimum seven strand, 5/16-inch diameter wire with a breaking strength of 8,000 pounds, double galvanized in accordance with AASHTO M 111.

Aluminum Structures. Sections 720.01 and 720.02 of the Standard Specifications shall apply.

643.04 Traffic Signal Controllers and Cabinets

The controller shall meet, as a minimum, all applicable sections of the NEMA Standards Publications for ATC. The controller shall be a Cobalt Rackmount as manufactured by the Econolite Control Group, part COBRM21130110000.

643.041 Bench Test

All components of the controller and cabinet shall be bench tested for a minimum of 72 continuous hours by the Contractor at the Contractor's facility prior to delivery to the project. A representative of the Authority shall verify the test check list. The Contractor shall notify the Authority at least 3 days prior to testing as to the date, time and place that tests are to be performed. Testing shall be performed by a Level 2 (or higher) IMSA qualified Signal Technician using a test

board and in conformance with the design loads, phasing, timing and auxiliary equipment such as pre-emption phases. Any defective component shall be replaced, retested and continuous testing continued. Test results shall be documented on a check list as provided by the Authority and these results attested by the signature of the performing technician. Upon completion of satisfactory bench testing, a written approval will be supplied to the Contractor by the Engineer for delivery to the project only. This approval does not relieve the Contractor from ensuring proper operation of the equipment. The approval shall accompany the cabinet and controller when delivered to the project.

The checklist will contain the following items:

(a) Install all of the equipment into the cabinet as required per the plans and specifications.
(b) Set the phase timings of the controller in accordance with plans.
(c) Wire in 48 VDC Cabinet Test Display to the switch packs in simulation to the intersection as per the plans.
(d) Check all of the wiring connections for physical tightness.
(e) Power up the cabinet.
(f) Observe the sequences, timings and operations of the controller in conformance to the plans and specifications.
(g) Using the phase test push buttons, insert a call for a phase and observe this phase as it is being called for sequencing, timing and returning to rest condition. Only one separate call for each phase shall be used.
(h) Test the police panel switches, manual, on/off, flash/auto and test the police manual cord if present in the panel.
(i) Test for Fire Pre-emption - Optical Detector - with the receivers wired in the cabinet and using an emitter, test each fire run as per the plans. Hard Wired - Attach a temporary push button as per the plans and test each fire run as per the plans.
(j) Check exhaust fan controls by applying heat from a 100 watt lamp on an extension cord to the thermostat.
(k) Check heater controls by cooling the thermostat. (if equipped)
(l) Check conflict monitor by testing for any conflicting Greens or Yellows by the use of a jumper wire attached to a displayed Green or Yellow and to the other non-parent Greens or Yellows to ascertain that conflicting colors are not present.

When all of the above procedures have been completed, the performing technician shall document the results on the approved form as provided by the Authority.

643.042 Controller Cabinet

The cabinet shall meet, as a minimum, all applicable sections of the ATC 5301 v02 StdHLD (most current revision) Standards Publications for ATCC. The ATC Cabinet shall include all of the Authority required items supplied in the following Econolite Cabinet Part Numbers:

48VDC ATCC 32 Channel Output / 24 Channel Input shall be Econolite Part Number ATCC1032.

643.043 Component Spares

The following will be provided as spare equipment, per intersection: 2 SIUs; 3 High Density Switch Packs; one 2212-LV Cabinet Monitor Unit with Datakey, one Monitorkey Programming Tool, 5 High Density Flash Transfer Relays, 1 APS PBS and 1 - 4 channel DC Isolator card. One ICCU-s2 shall be provided for the project.

643.05 Fire Pre-emption

Fire pre-emption shall be activated by optical detection equipment with optical detectors. Fire pre-emption shall clear the existing phase through a normal clearance followed by the fire phase as shown on the plans for the minimum time specified. The fire phase shall give a green in the called direction; the confirmation light shall be activated as requested by the local municipality. Upon release of the fire pre-emption, the controller shall provide a green to the major movement. Phase selector will be Opticom by GTT model 764, there shall be no approved equal. All software and cabling from the manufacturer will be supplied to the Authority to allow communication to the device with a PC.

The engineering, design, and integration of the fire pre-emption shall be by the manufacturer of the equipment, in cooperation with the supplier of the signal controller equipment. Preemption receivers will be Opticom model 7XX series as required.

The confirmation light shall be 48 Volt DC and operated by a HDSP (i.e., channel #9 Yellow).

Optical detector locations shall be verified by the Authority and local fire department personnel to assure optimum reception. Optical detector cable shall run unspliced from the optical detector head to the controller cabinet.

Each optical detector lead-in cable shall be marked with plastic tape as per section 643.10 “Phase color code” of this special revision. The fire preemption markings shall correspond to the following chart associating the fire preemption call with its corresponding phase:

PREEMPTION PHASE CODE	
Preempt 3	Phases 1 & 6
Preempt 4	Phases 2 & 5
Preempt 5	Phases 3 & 8
Preempt 6	Phases 4 & 7

The fire preemption system shall be tested during the bench test period as described in Section 643.041 of this special provision. The system will be tested again at the completion of the project and any components found to be non-functioning shall be replaced by the contractor at no cost to the Authority. Both of the pre-project and post project testing will be performed in the presence of a representative of the Authority.

As part of this project, the contractor shall supply one spare Model 764 phase selector card and 2 model 711 optical receivers.

643.06 Vehicle Detection

The Work shall consist of furnishing and installing a FLIR Trafisense2 Dual, video-based vehicle detection system (henceforth referred to as 'sensor' in this section). There will be no approved equal. The system shall interface with the signal controller via a BPL2 Edge card and SDLC, the card furnished shall have the ability via a firmware update to support SIU communications in the future. The contractor shall supply an interface panel compatible with a 48VDC ATC Cabinet. The contractor shall also supply all additional cabling, mounting hardware, cabinet interfaces and any other component required to provide a complete detection system described herein. Each approach shall be covered using one sensor. Capturing more than one approach with a single sensor will not be permitted.

Each sensor, shall be mounted on 72" risers or as recommended by the manufacturer. The sensor will be raised as high as practically possible. The risers shall be of the Pelco Galaxy type, with gusseted tube and the AB-3055 hinged clamp or approved equal. The use of u-bolts will not be permitted.

Where queue detection is indicated on the plans the contractor shall furnish a four channel DC Isolator card for accepting the input for the queue detector. The contractor shall also be responsible for programming the controller as per the plans. The Authority will provide and configure the necessary field equipment to provide the input to the controller.

The contractor shall install all systems in this section in accordance with manufacturer specification and guidance. All cabling shall be furnished by the manufacturer, unless approved otherwise by the Authority, resident and manufacturer. Plan locations of devices is only typical, field guidance from a manufacture representative on placement of a unit shall take precedence over their location on the plans. Field locating of the sensor units shall be considered incidental to the project. If the units are improperly placed, relocation of the units to the manufacture suggested location, and any re-aiming, replacement or other work thereto shall be considered incidental to the project.

Each sensor shall be grounded, the ground for each sensor shall be minimum 12awg green wire and be bonded with the mast arm ground. Drilling and tapping, or the use of self-tapping screws into the mast-arm shall not be permitted.

At least 10 feet of extra sensor cable shall be coiled and neatly stored in the nearest pull box. Storing extra cable in the mast arm shall not be permitted.

There shall be a service loop not to exceed 3 feet of cable at each sensor, the cable shall be coiled and secured neatly at each unit.

Field wiring in the cabinet, sensor cable in junction boxes and at each sensor shall be labeled as to what phases they serve per section 643.10 "Phase color code" of this special provision. All terminations in the cabinet shall conform to manufacture recommendations and cables shall be secured neatly.

All detection equipment and sensors described herein shall be operational, powered and their operation demonstrated during the bench testing period described in section 643.041 Bench test of this Special Provision.

As part of this project, the contractor shall supply one of each of the following per intersection as detection equipment spares; Traffisense2 Dual unit and any applicable mounting hardware, BPL2 EdgeCard, interface board for 48VDC ATC Cabinet.

643.07 Contacts

All contacts used in connection with interval indications shall be of pure coin silver or equivalent, and shall be capable of breaking and carrying 15 A at 125 V alternating current. The contacts shall be readily accessible and capable of being replaced in the timer without the use of any tools other than pliers and screw driver.

643.08 Meter Pedestals

Power will be provided by the Maine Turnpike Authority.

643.09 Radio and television interference

Electrical equipment shall be prevented from interfering with radio and television reception.

643.10 Cable and Wire

Cable shall be plastic covered cable meeting the applicable requirements of the International Municipal Signal Association (IMSA) 20-1 specifications. The conductor color coding shall not be by means of printed code. All wiring shall be new and copper. Reuse of existing cable will not be allowed. Actual color coding shall be used. Wiring will not be paid for separately but will be incidental to the respective signal item. The minimum size wire for the circuits shall be as follows:

	Minimum A.W.G. #
(a) Feeder to Cabinet (Northbound)	2 Stranded
(b) Feeder to Cabinet (Southbound)	2 Stranded
(c) Cabinet to Pole or Pedestal	12 Stranded
(d) Cabinet to Luminaire	10 Stranded
(e) Pole or Pedestal to Receptacles	12 Stranded
(f) Equipment Grounding Conductor	8 Stranded

Each lead-in cable shall be marked with plastic tape corresponding to the following color code to identify which phase it pertains to at the splice(s) in both the pull box(es) and in the cabinet.

PHASE COLOR CODE

Phase 1	1 Blue
Phase 2	1 Green
Phase 3	1 Yellow
Phase 4	1 Red
Phase 5	2 Blue
Phase 6	2 Green
Phase 7	2 Yellow
Phase 8	2 Red

Traffic signal conduit, pull boxes, frames, and covers shall conform to Section 626 of the Standard Specifications. Conduit for all lines shall be 3 inch in diameter unless noted on the plans. Unless otherwise noted, all conduits shall be schedule 80 PVC.

643.11 Painting

Prior to erection and assembly, if not manufactured of polycarbonate material, the entire traffic or pedestrian signal housing and visors shall be painted with an approved zinc-rich primer and a finish enamel coat as noted below. All paint shall conform to Section 708 of the Standard Specifications. The following colors of enamel shall be used:

(a) Controller Cabinet	Outside: Natural Aluminum
(b) Housings	Black (2)
(c) Visors	Inside: Black (2); Outside: Black (2)

Federal Number
(1) Green Enamel = H8-577
(2) Black Enamel = 17038
(3) Federal Yellow Enamel = 13538

After the signals have been completely installed, two coats of enamel shall be applied to all unpainted or scratched surfaces after the surface has been lightly sanded to remove gloss.

643.12 Interconnect

Interconnect for the VMS between the signal control cabinet and the toll plaza will be accomplished via fiber optic cable. Interconnect cable shall be 6-strand multimode fiber optic cable in accordance with Section 655. Interconnect cable, where installed in conduit, shall be suitable for outside plant installations in an underground environment. Interconnect cable shall be run underground, with no splices from a 6-postion fiber optic termination panel located within the traffic signal cabinets to a 6-position fiber optic termination panel located in the data room at each toll plaza utility building. The fiber optic patch panels shall be field located in both the cabinet and toll utility building as per the resident or Authority. The fiber optic patch panels shall be incidental to this work.

Network switches will be provided by the Authority and shall be field located, and final network setup, IP addressing and verification of communication shall be performed by the Authority in coordination with the contractor.

Interconnect between the 2 signals and the Jenkins Road signal will be accomplished wirelessly with equipment by Ubiquiti. The contractor will only be required to install and perform the initial setup on the wireless interconnect equipment at the Northbound and Southbound ramp intersection signals. The Authority will supply the wireless interconnect equipment. The equipment shall be installed to the manufacturer's specification. All final setup and testing will be done by the Authority.

643.13 Construction Requirements

All traffic signal and electrical installations shall comply with the requirements specified herein, local and utility codes, MUTCD, and the National Electrical Code (NEC). All employees of the signal subcontractor shall have an OSHA 10 Hour Certification. The signal subcontractor shall have at least one representative onsite at all times with an IMSA Traffic Signal Level 2 or higher Field certification.

A preconstruction meeting with the Contractor, signal Subcontractor, Engineer and Maine Turnpike Authority representative shall be arranged not less than 3 days prior to the start of signal installation, to resolve any problems.

Upon commencement of any signal work within the intersection, the contractor will be responsible for any ongoing trouble calls at the intersection. There will be no separate payment for this work but shall be considered incidental to the traffic signal modification item.

Any operating traffic signal shall be left in a non-flash operating condition at the end of each work day, with or without detection.

The signal Subcontractor shall notify the Maine Turnpike Authority ITS / Toll Manager no less than 3 days prior to final inspection of signal installation. This final inspection is required prior to signal activation.

Each signal head mounted on a mast arm shall be installed with a 1/8-inch diameter aircraft cable, looped around the mast arm and mast arm bracket, as a safety device to prevent the signal head from falling. Cable ends shall be fastened by two opposing "U" clamps. When suspended by this cable, the top of the signal head shall be no more than 6 inches below the bottom of the mast arm.

All conduit lines necessary shall be constructed for the proper operation of the signals and shall conform to Section 626 of the Standard Specifications.

All conduits terminating in the cabinet, mast arms or junction boxes shall be sealed.

Concrete foundations with anchor bolts to secure the traffic signal structures, flasher or controller cabinets, and meter pedestals, shall be installed at the locations specified on the plans. The concrete foundation for the controller cabinet shall be raised a minimum height of 3 inches up to a maximum height of 18 inches above the finished surface as directed by the Resident. Chamfer strips shall be used on all signal controller cabinet foundations. Forms shall be inspected before concrete is placed. The use of a precast foundation for the controller cabinet will not be permitted.

Poles shall not be mounted on the leveling nuts until the concrete has cured for at least 7 days or attained a minimum of at least 80 percent of its design compressive strength.

Provide protection for wiring from rodents and other elements as approved by the Engineer and/or as shown on the Plans.

Prior to placing the controller cabinet on its foundation, silicone sealant shall be applied to the area of contact.

The Contractor shall use bolt pattern templates when setting mast-arm anchor bolts, signal pedestal bolts and controller cabinet mounting bolts. The templates shall remain in place for a minimum of 24 hours.

Wood poles shall be placed in the ground to a depth of 20% of their overall length, with a maximum deviation from the vertical of ¼ inch in 5 feet.

Wood poles with a back-guy cable shall be placed in the ground to a depth of 20% of their overall length. Poles shall be back-guyed using a 10-inch expanding anchor with a 3/4 inch by 96-inch anchor rod. Thimble eyes of anchor rods shall extend 12 inches above finish ground. Cable used for back-guying shall be attached to the anchor rod by a short bail automatic type grip and to the guy hook on the pole by a preformed type grip. The pole shall be drilled 14 inches from top and a 5/8-inch oval eyebolt installed with one square flat washer and square nut on the messenger side and one square washer, square nut and guy hook on the opposite side. Any guy wire, messenger wire or span wire installations done on Utility Company poles shall follow Utility Company requirements.

643.131 Backfill for foundations

Unless otherwise ordered, backfill for foundations shall be material conforming to the requirements of Section 203.26 of the Standard Specifications – Gravel Borrow.

643.132 Service and Meter Box

Electrical Service for the signals will be provided by the Authority. The contractor shall run the needed conduit and wiring from the signal cabinet to the newly constructed clean power panels at both toll plaza locations as indicated on the plans. The contractor shall provide and install a breaker in the clean power panel and any other items needed to complete the installation. This work shall be incidental to the project.

643.133 Signal Cable and Wire Installation

The Contractor shall furnish and install sufficient cable and wire to operate the system properly and at least 4 spare conductors in each cable run shall be provided. Pulling a separate cable to achieve the required number of spares will not be allowed.

Each approach to the intersection shall have a dedicated cable run from the controller cabinet.

No more than one cable shall be permitted in a conduit except to eliminate splices in pull boxes. When more than one cable is permitted the area of combined cables shall not exceed 30 percent of the inside area of the conduit.

Messenger cable shall run un-spliced between poles and shall be installed with a 5 percent sag in the wire when measured from the point of attachment to the middle of span. The cable shall be attached to the pole eyebolt by a preformed type grip on one end and an automatic type grip on the opposite end. Messenger cable shall be grounded to the back-guy cable.

Signal bases, housings and controllers shall be furnished and installed as required. All structures and housings shall be plumb after erection.

Miscellaneous electrical equipment. All additional electrical fittings, service conduit, switches, fuses, traffic signal bulbs, and such other hardware as is necessary to properly and securely install the equipment shall be furnished. All electrical fittings shall be weatherproof.

Wiring and connections. All connections shall be spliced, soldered, compounded, and taped. The use of wire nuts will not be permitted. A minimum of 18 inches of wire will extend outside of the mast arm handhole. The following color code shall be used:

(a) Red Wire	Red, Artery
(b) Orange Wire	Yellow, Artery
(c) Green Wire	Green. Artery
(d) Red with tracer	Red, Side Street
(e) Orange with tracer	Yellow, Side Street
(f) Green with tracer	Green, Side Street
(g) White	Neutral or DC Negative for all signals
(h) Blue	All steady burning arrows
(i) Blue with tracer	Intermittent arrows
(j) Remaining	Push buttons and spares

Note: The white wire shall be used for all neutral or DC Negative connections and shall be connected to the service ground.

No street lighting splices will be permitted in the mast-arm shaft. Splices for street lighting and lightning arrestors shall be located inside the nearest pull box.

Ground connections. All installations and equipment shall be bonded and grounded to the service ground rod in accordance with the requirements of the electric power company and the NEC.

Each signal cable run shall be installed with one green plastic covered copper ground wire to which all equipment shall be bonded in accordance with standard practice. Each base and post, cabinet, and any other component that would be considered a part of the signal system shall be bonded to the ground wire. This ground wire shall be connected to the ground rod at the controller cabinet.

643.134 Installation of signals and equipment

The signals and equipment shall be installed by competent workmen or the manufacturer's representative.

Prior to placing the signals in operation, the signal housing shall be hooded with approved non-transparent material or turned to clearly indicate that the signals are not in operation.

Signs mounted on the signals not applicable to construction conditions shall be covered as specified in Section 645 of the Standard Specifications.

All material including poles, foundations, fittings and cable shall be supplied and installed to make a complete operative installation.

Signs installed on signal arms shall be mounted with "Astro Sign Bracs" at a right angle to the roadway. Signs mounted on span wire shall be mounted with Pelco "Span Wire Sign Hangar Assemblies," or approved equal. Tubes, where used-for the brackets, shall be held in place by the use of a hinged clamp, Pelco AG-3055 or approved equal. The use of u-bolts will not be permitted.

All male threads, ie bolts, machine screws, threaded hubs, nipples, hand hole cover bolts, etc. shall have a coating of anti-seize compound as approved by the resident. The compound shall be field applied before the affected parts are assembled.

The contractor or signal subcontractor shall be responsible for providing the Authority a complete set of "As-Built" plans for the intersections at the completion of the project.

Upon completion of the project the contractor shall supply 3 printed and bound and 1 digital copy in PDF form of all manuals including but not limited to: traffic signal programming, preemption, cabinet and video detection.

643.14 Operation

The Contractor shall commence the operation of the signal system only when permitted by the Engineer. Unless otherwise noted, signals shall be placed in flash a minimum of 1 week before the planned start of operation. New signals shall be made operational between the hours of 10:00 AM and 2:00 PM, Tuesday through Thursday, unless approved by the Engineer or Resident. A manufacturer's representative shall be present for when the signals are made operational.

Operating sequences shall be as shown on the plans or as ordered.

Operating sequences shall be verified by testing.

In cooperation with the Fire Department, the Contractor shall make trial runs to ascertain proper timing of the fire pre-emption system. The minimum time shall be approved by the Chief of the Fire Department or the Chief's representative.

The Contractor shall provide a qualified technician to thoroughly review and confirm that the system is satisfactory and operational as designed. Prior to the signals being made operational, the Contractor shall have a review with the Authority's Toll / ITS Manager and local officials

(including Fire Department technician) to review and comment upon the system. The contractor shall make a good faith effort to address any complaints received during this review.

643.15 Warranty

Upon completion of the project, the Contractor shall forward to the Authority all warranties to the purchaser that the equipment which has been installed hereunder shall be free from defects in materials, workmanship and title, and shall be of the kind and quality designated or described in the Contract. The foregoing warranty supersedes all other warranties whether written, oral, or implied. If it appears within 24 months from the date of Acceptance of the work that the equipment installed hereunder does not meet the warranties specified above, the Contractor shall promptly correct any defect or nonconformance with the specifications. This warranty does not relieve the Contractor of the requirement of Section 106 of the Standard Specifications.

643.16 Method of Measurement

The traffic signals will be measured as a lump sum unit, per location complete in place. Vehicle detection systems will be paid as a lump sum unit, per location complete in place.

643.17 Basis of Payment

The accepted quantity of traffic signals will be paid for at the Contract lump sum price complete in place, including fiber-optic cable for the VMS system between the signals and toll plaza administration buildings, emergency pre-emption systems, and the installation of the wireless interconnect system for the two (2) traffic signals supplied by the Authority. The vehicle detection system items shall include furnishing and installing the vehicle detection system and delivery and installation of the MTA provided queue detection, including wiring and any incidentals for both vehicle detection and queue detection.

When an item of conduit appears in the Contract, conduit for traffic signals will be paid for under Section 626 of the Standard Specification. When no item for conduit appears in the Contract, any conduit required will be incidental.

The accepted quantity of mast arm poles with mast arms, dual-purpose poles and pedestal poles will be paid for at the contract unit price for each item. Payment shall be full compensation for furnishing, installing and materials, equipment and labor necessary to install poles and mast arms. Intersection lighting on dual purpose poles shall be paid for under 634.1751 Replacement LED Fixture – Supplied by the Authority.

All miscellaneous electrical equipment required shall be subsidiary.

Payment will be made under:

Pay Item		Pay Unit
643.80	Traffic Signal at Route 112 and Exit 35 SB	Lump Sum
643.81	Traffic Signal at Lund Rd and Exit 35 NB	Lump Sum
643.82	Vehicle Detection System at Lund Rd and Exit 35 NB	Lump Sum
643.83	Vehicle Detection System at Route 112 and Exit 35 SB	Lump Sum
643.92	Pedestal Pole	Each
643.941	Dual Purpose Pole w/15’ Mast Arm	Each
643.942	Dual Purpose Pole w/25’ Mast Arm	Each
643.943	Dual Purpose Pole w/30’ Mast Arm	Each
643.944	Dual Purpose Pole w/35’ Mast Arm	Each
643.945	Dual Purpose Pole w/40’ Mast Arm	Each
643.946	Dual Purpose Pole w/45’ Mast Arm	Each

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Barrier Reflector)

645.01 Description

This Section is deleted and replaced with the following:

This work consists of furnishing and installing new barrier reflectors on the top portion of the precast concrete median barrier in accordance with these specifications and as shown on the plans, details, or as established; including all labor material, equipment and incidentals necessary to complete the work, in conjunction with the rest of the project.

645.02 Materials

The reflectors shall be PCBM-T12 and shall be designed to be affixed to the top of the precast concrete median barrier by non-mechanical means, and when covered with reflective sheeting provides a directional visual cue to the location of the barrier wall and roadway. The design of the reflector shall provide twelve (12) square inches of surface area for application of retro-reflective sheeting of a specified grade during manufacture.

The T-shaped reflector shall consist of a flat rigid upper panel, to which is affixed retro-reflective sheeting, and a rigid base plate. Connecting these two components shall be a clear, UV-stabilized, flexible polyurethane hinge at least 0.5" in height. The polyurethane hinge shall be both mechanically and chemically attached to both the base plate and top panel. All materials shall be new.

The reflector units shall be constructed of a UV-stabilized, high-impact rigid thermo-plastic alloy conforming to the following material specifications:

Property	**ASTM Test**	**Results**
Tensile Strength @ Yield (min psi)	D638	6,400
Impact Strength @ 73F (Ft#/in) notched izod	D256	2.9
Impact Strength @ -4F (Ft#/in) notched izod	D256	2.3
Flexural Strength @ 73F (psi)	D790	12,000
Flexural Modulus @ 73F (psi)	D790	400,000

The "hinge" portion shall be constructed of a UV-stabilized, flexible thermo-plastic polyurethane conforming to the following material specifications:

Property	ASTM Test	Results
Specific Gravity (min.)	D 792	1.19
Hardness (min.)	D 2240	80 A
Tensile Strength @ yield, (min PSI)	D 412	4,600
Ultimate Elongation (min)	D 412	330
Compression Set (22 hrs. @ 70° C)	D 396	65
Tear Strength (min PLI)	D 624, Die C	600
Taber Abrasion (CS17 Wheel)	100 cycles	3 mg

The polyurethane "hinge" of the reflector shall have the following minimum dimensions in relation to rigid top panel and base sections:

- Wall thickness of the rigid top panel and base sections shall be min. 0.090";
- Wall thickness of the polyurethane hinge section shall be min. 0.090";
- Total surface area of the connection of the hinge to the upper top panel shall be minimum of 0.500";
- Total surface area of the connection of the hinge to the lower base plate shall be a minimum of 0.400."
- The polyurethane hinge shall protrude vertically into the top panel.
- The polyurethane hinge shall also protrude down into the base plate.
- The un-encapsulated section of the poly-urethane hinge shall be no less than
- 0.100" thick and 0.130" tall.

The reflectors shall be constructed of UV-stabilized polymers white in color. The color shall be solid throughout and stabilized to resist UV degradation. The polyurethane "hinge" shall be natural/clear in color.

All reflectors shall have retro-reflective sheeting applied to both sides of the top panel. Reflective sheeting shall be fluorescent yellow, and shall conform to the material requirements of Section 719.01 – Reflective Sheeting, for high intensity reflective sheeting. The sheeting shall be factory-applied to the reflector by the manufacturer.

645.03 Construction Requirements

The Contractor shall note that it is the Department's intention for barrier reflector installation to occur concurrently with the linear installation of the precast concrete median barrier, however, the contractor may perform this work on their timing, with Resident approval. All maintenance of traffic is incidental.

There will be no separate payment for the furnishing and installation of the new barrier reflectors, but shall be considered incidental to the lump sum Pay Item 526.35 – Precast Concrete Median Barrier.

Final location for the installation of the barrier reflectors shall be in accordance with Table 1 – Spacing of Reflectors as shown on the Plans, and as approved by the Resident.

The Contractor shall operate in a manner which prevents damage to the barrier reflectors during installation. The Contractor shall be responsible for replacement and reinstallation of

barrier reflectors damaged during the Contractor's operations. No additional payment shall be made for replacement and reinstallation of barrier reflectors damaged as a result of the Contractor's operations.

645.04 Method of Measurement

The quantity of Barrier Reflectors shall not be measured for payment, but shall be considered incidental to Pay Item 526.35 – Precast Concrete Median Barrier.

645.05 Basis of Payment

No separate payment will be made. Payment shall be considered incidental to the related pay items for Median Barrier, Bridge Endpost Median Barrier Transition, and Guardrail Median Barrier Transition.

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Protection of Signs with Type XI Sheeting)

645.04 Fabrication of Type I Guide Signs

The following paragraphs are added after the second paragraph in part b. Reflective Sheeting:

The Contractor and Sign Fabricator shall exercise all due caution to avoid any creases, bends, tears, punctures, or other damage to any Type XI sign sheeting, perceptible or not. Sign sheeting shall be protected at all times following application to the extruded aluminum surface. Any defect which becomes perceptible either under direct, indirect or no light conditions shall be cause for rejection of the sign panel.

Following the application of the sign legend and borders, the sign panel shall be protected from all hazards that may cause a defect to the sign sheeting (either background, legend or borders) in accordance with the manufacturer's recommendations. Fabricated signs shall not be stacked during storage, transport, or erection such that concentrated pressure is placed on one area of the sign face that is not uniform across the full sign face.

645.08 Method of Measurement

The fifth (5th) paragraph is deleted and replaced by the following paragraph:

The area of roadside guide signs, regulatory, warning, confirmation and route marker assembly signs of the respective types, will be measured by the area in square feet, computed to the nearest hundredth of a square foot (0.01 SF), as determined by the overall height multiplied by the overall width. Any defect in the surface area of the sign that becomes perceptible under direct, indirect, or no light conditions shall be cause for rejection of the whole sign panel.

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Remove and Stack Sign)
(Remove and Reset Sign)
(Remove and Dispose Sign)

645.02 General

The following paragraph is added:

Existing signs noted to be removed and reset shall be maintained until the new location is ready for the reset. The contractor will be required to provide temporary signing for all signs that are not reset within the same day as removal. Similarly, all new signs that replace existing signs shall be set within the same day as the existing sign is removed or temporary signing shall be provided. The contractor shall submit a plan for all temporary signing, including location and support, for MTA approval.

645.07 Demounting and Reinstalling Existing Signs and Poles

The following paragraphs are added:

At locations noted on the Plans, existing ground-mounted signs are designated to be removed and reset. This work shall consist of removing the sign panels, removing and resetting or disposing of the existing wood post and resetting the sign panels on a new wood post if required in the appropriate specified location. The Resident will determine if a new wood post is required.

At locations as shown on the Plans, existing ground-mounted signs are designated to be removed and stacked. This work shall consist of removing and delivering existing sign panels, solar panels, posts, concrete foundations and breakaway devices to the MaineDOT Pleasant Hill Maintenance Lot in Scarborough. Contractor shall coordinate delivery with Resident. Excavations shall be backfilled and ground restored to the satisfaction of the Resident.

All other signs shown to be removed and disposed shall consist of demounting and removing the existing sign panels and disposal by the Contractor. Steel supports, precast foundations in good condition, and breakaways that are removed with signs that are removed and disposed shall be stacked in the same manner as supports for signs that removed and stacked. Other foundations shall be disposed of by the contractor.

Any existing signs not shown on the Plans are to remain in their existing condition unless directed otherwise by the Resident.

Steel H-beam supports salvaged to the Authority shall be labeled by size, shape, and length and stacked by approximate sizes at the Sign Shop as directed by the Authority. The label shall also note if the post has been drilled for mounting a breakaway kit (lower half) or breakaway splice plate (either lower half or upper half).

645.08 Method of Measurement

The following sentences are added:

Removing and Resetting existing ground-mounted signs shall be measured as complete units each, removed, reset and accepted.

Removing and stacking existing signs shall be measured as complete units each removed and stacked.

Removing and disposing existing signs shall be measured as complete units each removed and disposed.

645.09 Basis of Payment

The following paragraphs are added:

The accepted signs Removed and Stacked will be paid for at the Contract unit price each as specified. Such price will include removing, disassembling, and stacking sign panels and supports, and precast foundations in good condition at the location specified. Payment shall also include disposing of other foundations. Ground restoration shall be paid for under the appropriate contract pay items.

The accepted signs Removed and Reset will be paid for at the Contract unit price each as specified. Such price will include removing and resetting sign panels, removing and resetting or disposing existing wood post and resetting the sign panels on the existing or new wood post and new hardware as required to complete the sign installation. Any signs or supports damaged by the Contractor shall be replaced by him with new signs or supports conforming to the applicable Specifications at no additional cost to the Authority.

The accepted signs Removed and Disposed shall be paid for at the Contract unit price each as specified. Such price shall include demounting, removing, and disposing the sign panels, removing, disassembling, and stacking the sign supports, breakaways at the location specified, and precast foundations that are not reused and in good condition. Payment shall also include disposing of other foundations. Ground restoration shall be paid for under the appropriate contract pay items.

Payment will be made under:

Pay Item		Pay Unit
645.105	Remove and Stack Sign	Each
645.109	Remove and Reset Sign	Each
645.1099	Remove and Dispose Sign	Each

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Canopy Mounted Dynamic Message Sign)

645.01 Description

This work shall consist of the installation of a canopy mounted dynamic message sign (DMS) located above the center lane of the new Exit 35 Southbound and Northbound toll plazas. All needed electrical and communication wiring will be included as part of the installation. The contractor shall coordinate with the MTA Toll system and ITS manager for sign installation.

All needed electrical and communication wiring will be included as part of the installation. Each sign is mounted on framing supports and mounted on brackets to the top of the toll plaza canopy.

The contractor shall provide power wiring and two (2) direct burial type, Category 5e shielded cables and needed conduit. One will be routed from the canopy mounted DMS to the toll booth counter for the center lanes NB and SB toll plazas and the other will be routed from the canopy mounted DMS to the lane controller in the booth. A ten (10) foot slack loop of cable for routing of the cable within the booth shall be provided.

645.02 Materials

The DMS to be installed at the new Exit 35 SB and NB toll plazas will be the following:

Daktronics model VS6-48x160-26.4-RGB SF, or approved equal. The Sign shall also include a DM-100 hand controller or approved equal.

645.04 Method of Measurement

Canopy Mounted Dynamic Message Sign shall be measured by the lump sum for provision and installations accepted by the MTA.

645.05 Basis of Payment

Canopy Mounted Dynamic Message Sign shall be full compensation for the installation of the new DMS on the toll canopy over the center toll lane at the new Exit 35 SB and NB toll plazas, and for all other materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
645.1092	Canopy Mounted Dynamic Message Sign	Each

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Canopy Mounted Sign)

645.01 Description

The following paragraphs are added:

This work shall consist of furnishing and installing new Canopy mounted signs fabricated from sheet aluminum with aluminum angle windbars as identified in the Plans. Each sign is mounted on framing supports and brackets to the top of the toll plaza canopy with an attached luminaire.

645.021 Materials

The following paragraph is added:

LED Fixture shall be:

- Model # SVLED2-PNL-PK1-MVOLT-40K-AMT-GYSDP-AO from Holophane.

Photocell and receptacle shall be:

- Intermatic K122 NEMA locking type receptacle (3 Pin) with 3 Pin locking type electronic photocontrol 120-277V or approved equal.

645.08 Method of Measurement

The following sentences are added:

Canopy Mounted Signs will be measured by each complete unit of the kind specified and installed.

645.09 Basis of Payment

The following paragraphs are added:

The accepted quantity of Canopy Mounted Sign shall be paid for at the Contract unit price each as specified. Such price shall include all hardware, labor and equipment necessary to complete this task. The item also includes all necessary aluminum angle windbars, electrical wiring, conduit, tenon, luminaire, photocell, receptacles, and fittings.

Payment will be made under:

Pay Item		Pay Unit
645.14	Canopy Mounted Sign	Each

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Overhead Guide Sign)
(Cantilever Guide Sign)

645.023 Support Structures

The first (1st) paragraph of part b is deleted and replaced by the following paragraph:

b. Bridge, Cantilever, and Butterfly Type Sign Supports The Contractor shall be responsible for the design of the support structure. The foundation has been designed and detailed in the Plans.

645.024 Bridge, Cantilever and Butterfly Support Structure Foundations

This subsection is deleted in its entirety and replaced with the following:

The Authority has completed an appropriate test boring program to evaluate subsurface conditions in the general vicinity of proposed foundations. The foundation requirements are provided on the Plans. Drilled shafts shall not be permanently cased, except for the top 3.0 feet; concrete shall be cast directly against the surrounding soil. The Supplier shall determine the Bending Moment, Shear Force, Torsion, and Axial Load at the top of each mast arm or dual-purpose pole foundation. The Contractor may propose an alternate shallow spread footing or drilled shaft design than that set forth on the drawings. Any Contractor-prepared foundation design shall meet the requirements set forth in Section 626.034 – Concrete Foundations, except geotechnical and structural foundation design shall be in accordance with AASHTO LRFD Bridge Design Specifications, current edition, and LRFD Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, current edition. The Contractor shall not commence foundation construction prior to receiving approved sign structure shop drawings and calculations.

645.09 Basis of Payment

The second sentence of the third (3rd) paragraph is deleted and replaced with the following:

Such price will be full compensation for the signs, support structures, foundations, soil and rock excavation, dewatering and fine grading and incidentals necessary to complete the work.

The thirteenth (13th) paragraph is deleted.

This subsection is amended by the addition of the following:

Payment will be made under:

Pay Item		Pay Unit
645.121	Overhead Guide Sign NB 1 (Sta. 1670+75)	Lump Sum
645.151	Cantilever Guide Sign NB 1 (Sta. 1718+50)	Lump Sum
645.152	Cantilever Guide Sign NB 2 (Sta. 1731+30)	Lump Sum
645.153	Cantilever Guide Sign SB 1 (Sta. 2728+75)	Lump Sum
645.154	Cantilever Guide Sign SB 2 (Sta. 2740+50)	Lump Sum
645.155	Cantilever Guide Sign SB 3 (Sta. 2763+00)	Lump Sum
645.156	Cantilever Guide Sign SB 4 (Sta. 1789+00)	Lump Sum

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Sheet Aluminum Overlay, Type 1)

645.01 Description

The following paragraph is added:

This work shall consist of furnishing and installing sheet aluminum overlays for Type 1 guide signs in accordance with these specifications and in reasonably close conformity with the Plans.

645.021 Materials

The following paragraph is added:

Sheet aluminum overlays shall be fabricated from 0.080 inch thickness sheet aluminum and conform to Section 719.04.

645.04 Fabrication of Type I Guide Signs

The following section is added:

d. Sheet Aluminum Overlays The sheet aluminum overlays shall be field applied to the existing sign panels. Overlays shall be applied to the existing sign panel by use of pop rivets, in accordance with standard commercial processes, as approved, with a maximum rivet spacing of 12".

645.06 Installation of Type I Signs

The following section is added:

c. Sheet Aluminum Overlays Prior to fabrication of the sheet aluminum overlays, the Contractor shall carefully measure the area of the existing text to be covered by the sheet aluminum overlay. The area measurement (width and height of the area to be covered) shall be submitted with the shop drawings to the Resident Engineer forreview.

645.08 Method of Measurement

The following paragraph is added:

New sheet aluminum overlays installed on existing guide signs will be measured by the area in square feet, computed to the nearest hundredth of a square foot, as determined by the overall width multiplied by the overall height of the overlay panel.

645.09 Basis of Payment

The following paragraph is added:

The accepted sheet aluminum overlays to be fabricated and installed on existing guide signs will be paid for at the contract unit price per square foot of overlay. Such payment will be full compensation for furnishing and installing sheet aluminum overlays, assembly and attachment hardware, and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
645.2511	Sheet Aluminum Overlay, Type 1	Square Foot

SPECIAL PROVISION

SECTION 645

HIGHWAY SIGNING

(Remove and Reset Mainline Sign)

645.01 Description

The following paragraphs are added:

This work shall consist of removing and resetting the existing highway guide signs as shown on the Plans. The work includes a combination of the following: removal, resetting, modifying, furnishing, and disposal of concrete foundations, steel posts, wood posts, and breakaway foundations. Existing materials from the existing sign installation may be reused to reset the existing sign or another sign.

This work shall consist of removing and resetting the existing overhead guide signs as shown on the Plans. The work includes unbolting and removing the existing sign from sign structure and reattaching the existing sign to the sign structure. Existing materials from removing the existing sign may be reused to reset the existing sign.

The signs' message shall remain visible to turnpike drivers at all times unless other provisions have been approved.

645.02 General

The following sentences are added:

New concrete foundations shall conform to the requirements of Section 626 and shall be in conformance with the Maine Department of Transportation Standard Details in conjunction with the information shown on the Plans.

Breakaway devices shall be B525 or B650 as manufactured by Transpo Industries, Inc. (www.transpo.com).

645.05 Signs

The following paragraphs are added:

The removal and resetting of the mainline signs shall be completed in accordance with the details as shown on the Plans. The Contractor shall keep all signs visible to turnpike drivers except for the period of time necessary to actually complete the relocation. The sign panel shall not be removed and relocated until after the proposed sign support system (foundation and posts) have been installed in the final location. One (1) working day is allowed for the sign relocation.

The Contractor may elect to utilize all new materials or reuse materials from other sign locations that have previously been reset. The cutting of structural steel post shall be accomplished

by mechanical means. The use of burning to cut shall not be allowed. One single connection will be allowed to extend a post to the required length. A full penetration weld or a bolted splice shall be required for the connection. The Contractor shall submit his proposed connection method to the Resident for approval. Any damaged area shall be repaired with two coats of zinc-rich chromium paint. Material removed from an existing sign location and not reused at a proposed sign location shall become the property of the Contractor.

All signs posts on breakaway foundations shall be installed in accordance with the Specifications for breakaway devices. Multipost signs shall be constructed with the required splice as in accordance with the Plans.

645.08 Method of Measurement

The following sentence is added:

Remove and Reset Overhead Mainline Sign shall be measured for payment as one lump sum for each sign number as shown on the Plans.

Remove and Reset Mainline Sign shall be measured for payment as one lump sum for each sign number as shown on the Plans.

645.09 Basis of Payment

The payment for Remove and Reset Mainline Sign and Remove and Reset Overhead Mainline Sign shall be at the Contract lump sum price for each sign number. This payment shall be full compensation for furnishing all new materials, removing, modifying resetting existing material and signs, and all labor and equipment necessary to complete the installation in accordance with the details as shown on the Plans. This may include furnishing and installing new materials such as structural steel, concrete foundations, and single and multipole breakaway devices. Compensation for the excavation and backfill for the concrete foundation, as well as removal of the concrete foundation, shall be included in this item.

Payment will be made under:

Pay Item		Pay Unit
645.501	Remove and Reset Mainline Sign No. 1	Lump Sum
645.502	Remove and Reset Mainline Sign No. 2	Lump Sum
645.503	Remove and Reset Mainline Sign No. 3	Lump Sum
645.504	Remove and Reset Mainline Sign No. 4	Lump Sum
645.505	Remove and Reset Mainline Sign No. 5	Lump Sum
645.506	Remove and Reset Mainline Sign No. 6	Lump Sum
645.507	Remove and Reset Mainline Sign No. 7	Lump Sum
645.508	Remove and Reset Mainline Sign No. 8	Lump Sum
645.509	Remove and Reset Mainline Sign No. 9	Lump Sum
645.510	Remove and Reset Mainline Sign No. 10	Lump Sum
645.511	Remove and Resent Mainline Sign No. 11	Lump Sum

SPECIAL PROVISION

SECTION 648

FLAGPOLE

648.01 Description

This work shall consist of furnishing and installation of a 30 foot aluminum flagpole, ground mounted spot light and concrete foundation in accordance with these Specifications, and in reasonably close conformity with the lines and grades shown on the Plans or as approved by the Resident.

648.02 Materials

Flagpole shall be by American Flagpole, Concord Industries Inc. or EMC, a Division of Eder Manufacturing Corp.

Flagpole shall be a six inch diameter, seamless cone tapered aluminum 6063-T6 alloy, 30' height (exposed) with a mechanical Class I clear anodized finish for two flags. All fittings, such as ball finial, double revolving truck, two halyard and four snap hooks, tow cleats, and pole mounting assembly shall be as manufactured by or recommended by the flagpole manufacture.

Concrete shall be Class "AAA" cement concrete (4500 PSI).
Reinforcing steel shall meet the requirements of Section 503.
Lighting shall meet the requirements of Part II Division 800.

648.03 General

When flagpole is to be stored on-site for an extended period before installation, all wrapping material shall be removed and pole stored in a dry place, off the ground.

648.04 Method of Measurement

The flagpole will be measured by each unit. Lighting, conduit and wiring is included under Pay Item 800.01 Administration Building.

648.05 Basis of Payment

The accepted quantity of flagpole will be paid for at the Contract unit price each which payment shall be full compensation for furnishing and installing flagpole, and all accessories, foundation including anchor bolts, reinforcing steel, rubbing, penetration sealer, excavation, backfill, compaction, tools, equipment, labor and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
648.00	Install Flagpole	Each

SPECIAL PROVISION

SECTION 650

VARIABLE MESSAGE SIGN

650.01 Description

This work shall consist of furnishing, installing, connecting, configuring, and testing two new variable message sign (VMS) systems, their VMS controllers, ground mounted control cabinets, wireless communications systems, and solar power systems. This work also consists of system testing. The work also includes VMS steel support structures, including posts, bracing between posts, base plates, connection hardware, and anchor bolts. The VMS support foundations as well as conduits for power service and communications, are specified elsewhere in the Contract Documents.

One VMS system is to be located along the eastbound direction of Maine Route 112 (Buxton Road), west of the new signalized Exit 35 interchange with the Maine Turnpike (Interstate 95) at Station 144+30, RT. The second VMS system is to be located along the westbound direction of Maine Route 112 (North Street) east of the new signalized Exit 35 interchange with the Maine Turnpike at Station 170+72, LT. Both locations will be solar-powered and communicate via wireless radios with the closest signalized intersection, respective to each VMS location.

650.02 General

All equipment shall be new unless otherwise specified.

650.03 Materials

Materials shall meet the following requirements:

Electrical materials shall meet the standards herein, local and public utility codes, and the National Electrical Code (NEC).

Cabinets and enclosures shall meet the standards herein and the National Electrical Manufacturer's Association (NEMA) TS-4 standards.

All grounding and electrical installations shall meet the requirements of NEC, as well as all applicable state, local, and applicable public utility codes. All grounding shall meet the requirements of the manufacturers of the devices installed on the project. If the manufacturers' requirements are more stringent than those of the national, state, and local codes, then the manufacturers' grounding requirements shall apply.

The Contractor shall furnish and install Transient Voltage Surge Suppression (TVSS) device(s) for all power and communications conductors leaving the equipment cabinets, including ITS equipment and solar power cabinets, including but not limited to power service, and power and communications for all devices that are external to the cabinet.

The structural steel supports including posts, bracing between posts, base plates, connection hardware, and anchor bolts for the VMS shall meet the requirements specified in Section 720 of the 2014 MaineDOT Standard Specifications as well as the current edition of AASHTO "LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" including the latest interim revisions.

650.031 Variable Message Sign (VMS)

The VMS shall be a Ver-Mac Model B-1500C only; no alternatives will be considered.

The Contractor shall furnish and install all hardware required to attach the VMS panel to the applicable supports. VMS shall be mounted using two Zee bars attached along the top and bottom of the VMS panel. For ground mounted installations, the Zee bars shall be bolted to the steel H beams on each side of the web as shown in the Plans.

The Contractor shall furnish and install a four-inch-deep concrete work pad in front of the VMS panel and in front of the control cabinet. The pad shall be placed on a minimum of four inches of compacted granular material. The pad shall be set with at least one percent grade such that any water on the pad shall flow away from the cabinet. The pad shall be constructed using Class A concrete and the width of the concrete work shall be wide enough to provide stable platform for ladders accessing the VMS panel.

650.032 VMS Controller

The VMS Controller shall be a Ver-Mac V-Touch Controller only; no alternatives will be considered.

650.033 VMS Ground Mounted Control Cabinet

The VMS Ground Mounted Control Cabinet shall be ground mounted and installed at the locations shown in the Plans, and in conformance with all requirements shown in the Plans. The VMS cabinet shall consist of an aluminum weatherproof housing, and all ancillary equipment necessary to provide a complete, operational control cabinet for the VMS equipment. This work shall include all wiring, cabling, and connectors from the VMS cabinet to the VMS panel.

a. The VMS cabinet shall be NEMA 3R rated.

b. The VMS cabinet shall be a NEMA "P-44" cabinet meeting the requirements of Section 643 of the Maine Department of Transportation (MaineDOT) Standard Specifications, 2014 Edition, and all Revisions and Supplemental Specifications.

c. The VMS cabinet shall be secured to a concrete foundation provided by the Contractor as shown in the Contract Plans.

d. A concrete work pad shall be installed in front of the cabinet door as shown in the Contract Plans. The pad shall be set with at least one percent grade such that any water on the pad shall flow away from the cabinet. Where the work pad is installed on a slope, the depth of the pad shall be increased such that there is at least two inches of the concrete pad below grade.

e. Each cabinet shall contain a power panel. The power panel shall contain a primary circuit breaker, which will accept the incoming power from the solar power system or from the AC utility power. This primary circuit breaker shall serve as the electrical disconnect for the cabinet and shall shut off all cabinet power when in the "off" position.

f. The VMS cabinet shall protect the electronics and interfaces against sustained winds of 90 miles per hour (MPH), 120 MPH wind gusts, blowing sand and dust, roadside pollutants from vehicle exhausts, blowing rain and snow, and heavy ice accumulations.

g. The cabinet door shall be supplied and installed with a Corbin 1548-1 lock for access by VA9R keys.

h. The VMS cabinet shall be supplied with a captive door restraint bar. The bar shall allow the door to be kept open at a minimum of two different angles with one at 90 degrees and the other in the fully open position. The door restraint bar shall be supplied and installed such that the door is held in place during a 40 MPH wind without the restraint bar being bent. The door restraint bar shall be provided to prevent door movement when open in windy conditions.

i. Door hinges shall be continuous and bolted to the cabinet and door utilizing steel carriage bolts and nylock nuts. The hinges shall be made of a minimum 0.083-inch-thick aluminum and shall have a minimum 0.250-inch diameter stainless steel hinge pin. The hinge pin shall be capped at the top and bottom by a weld to prevent removal.

j. The top and bottom of the latching pushrods shall contain nylon rollers to promote secure door closure.

k. The door handle shall be stainless steel. The latching handle shall have provisions for padlocking in the closed position.

l. The VMS cabinet shall be covered by a one year dated warranty covering material defects for one year from date of acceptance.

m. The VMS cabinet shall contain a power switch mounted within the cabinet to control power to all duplex outlets. The cabinet shall include a minimum of two duplex outlets (total of four outlets), each rated for 15 amps.

n. The Contractor shall supply and install a thermostatically controlled electric fan in the cabinet to maintain the temperature within the field cabinet to that required by the equipment for outside temperatures as specified in these Special Provisions. Thermostats shall have the capability of being field adjusted from 50° F to 120° F.

o. All exposed, high voltage electrical terminals shall be insulated with non-conducting material such as rubber boots or silicon/rubber caulking.

p. The VMS cabinet shall be electrically bonded to all its associated metallic VMS support structure grounding systems, as described elsewhere in this document or in the Contract Documents.

q. All air venting arrangements shall contain air filters. The air filters shall have an average rated efficiency of 30% and an arrestance of 90% when tested in accordance with ASHRAE 52.1-1992 Test Standard. The filter shall be listed and rated Class 2 by the Underwriters Laboratories. Each cabinet shall be supplied with all required air filters. All fans shall be located above the air filters at the top of the cabinet.

r. All intake and exhaust vents shall meet NEMA 3R requirements with and without powering the air venting arrangements. All exhaust vents shall be furnished with a screen to prevent insects from entering the VMS cabinet.

s. The VMS cabinet shall be supplied and installed with an internal light located in the top of the cabinet inside the door. This light shall automatically turn on when the cabinet door is open and shut off when the door is closed. The light shall be hardwire connected to the cabinet's electrical power distribution buss.

t. The Contractor shall furnish in a watertight container a control cabinet-wiring diagram. Three sets of identical wiring diagrams shall be furnished for each cabinet and on a thumb drive provided to the MTA.

650.034 Ethernet Radios

The Ethernet Radios shall provide the communications interconnect means between the VMS Controller and the nearest signalized intersections' Ethernet Radios; continuing via wired cables (ethernet and fiber optic) to integrate with the Authority's communications system. The work shall consist of installing MTA supplied ethernet radios between the traffic signal controller and the DMS sign at both the Exit 35 northbound and southbound intersections. All miscellaneous cables, connectors, and brackets shall be considered incidental.

The Contractor shall install, integrate and test a Wireless Radio and Antenna system that will be provided and programmed by the Authority for use with the VMS controller and at the opposite end at the traffic signal controller.

The Contractor shall perform an "On-the-Air" test once the system is installed to confirm reliable operation, as defined above. The Contractor shall execute the approved radio system test plan and submit a test report to the Engineer. The Engineer will respond in writing within ten (10) working days, indicating acceptance or rejection. The Contractor shall address all comments from the Engineer and shall retest and resubmit all affected elements, as directed by the Engineer.

650.035 Solar Power System

The Solar Power System shall provide power to the VMS, VMS controller, VMS control cabinet, and wireless communications system. The Solar Power System shall meet the following requirements:

a. The Solar Power System shall consist of solar panels, solar panel support structures and foundations, batteries, solar power system equipment, an independent control cabinet to house the batteries and solar power system equipment, and all associated cabling.

b. The solar panel support structures and foundations shall meet the following requirements:

a. The solar array support pole and foundation shall be designed, stamped, and signed by a Professional Engineer licensed in the State of Maine. The design, materials, and fabrication of the solar array support pole and foundation shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" including the latest interim revisions as well as Sections 626, 645, and 720 of the 2014 MaineDOT Standard Specifications.

b. The solar panel support pole shall be a one-piece construction and shall conform to ASTM A595 Grade A, ASTM A500 Grade B or C, or ASTM A572 Grade 42, or an approved equal.

c. The solar array support pole shall be designed to support a solar array and all hardware subsidiary to the solar power system necessary to power all VMS equipment and auxiliaries. The support pole shall be designed for the number of solar panels as indicated by the approved solar power calculations. Close consideration shall be given to the effective projected area of the complete solar power system to be mounted on the pole along with the weight of attached hardware when designing the pole to meet the performance criteria, including consideration for all possible loading combinations including wind and ice loads; and the design stresses and allowable stresses for all components which comprise the proposed structure.

d. The structural calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base and at 5-foot pole intervals along the full height of the pole. At each of these locations, the following information shall be provided by the Contractor:

i. The pole's diameter, thickness, section modulus, moment of inertia, and cross-sectional area.
ii. The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each trapezoidal pole segment.
iii. The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR) at each elevation.
iv. The pole's angular and linear and angular deflection at each location.

e. Base plates shall conform to ASTM A709 Grade 36 or 50.

f. Foundations shall be cast in place. No precast foundations shall be permitted.

g. Anchor rods shall conform to the requirements of ASTM F1554 Grade 55 (minimum). Galvanize the entire rod per ASTM A153. Each anchor rod shall be supplied with a minimum of two hex nuts (ASTM A563 or ASTM A194) and a minimum of two flat hardened washers (ASTM F436).

h. All structural steel and non-stainless steel hardware shall be hot-dip galvanized and shall conform to the requirements of ASTM A123 or ASTM A153. All threads, whether connectors or conduits, shall have anti-seize compound applied.

i. The top of the foundation should be placed at least 3" higher than adjacent highest soil but not more than 4" higher than adjacent highest soil, unless otherwise specified in the Contract Documents.

j. All electrical materials shall meet all applicable state, local and public utility codes and requirements as well as the National Electrical Code (NEC).

k. The Contractor shall supply and install a grounding system at the base of the solar array support pole. The grounding system shall be connected to the pole through an appropriate ground clamp. A #4 AWG copper wire shall be installed between the support pole and the battery cabinet providing a common ground system for each terminus. A minimum one-inch conduit through the foundation to the inside of the pole shall provide the means to connect the ground wire from the inside of the pole at a ground lug to the ground rod(s).

l. Additional ground rods shall be installed to meet the manufacturer's recommended resistance to ground, or a maximum of 25 ohms, whichever is less.

c. The solar power batteries shall be sized to provide ten (10) days of autonomy to the VMS, VMS controller, VMS control cabinet, and communications device under no-light conditions. After ten (10) days of autonomous operation under no-light conditions, the batteries shall still retain at least 50% of their full capacity.

d. The batteries shall be sealed AGM type and shall be spill proof. The battery terminals shall be treated with a corrosion preventative spray.

e. The solar panels shall be sized to fully recharge the batteries in ten (10) days or less, while also supplying power to operate the VMS, VMS Controller, ITS Equipment Cabinet, and Communications Device, while under typical light conditions as defined by industry standard solar insolation maps for the State of Maine.

f. The solar panels shall be of the monocrystalline or polycrystalline type.

g. The mount for the solar panel array shall provide for adjustment of the angle of the face of the solar panels. The Contractor shall adjust the position of the solar panel array in a manner that maximizes solar exposure.

h. The Contractor shall locate the solar panel array in a location that results in no shadows being cast on the solar panels whatsoever at any time of the year. The Contractor shall consider the effects of leaves on trees, regardless of whether, or not, there are any leaves on trees at the time of installation.

i. The solar power system shall provide 24 hours per day of operation, seven (7) days per week, 365 days per year with no loss of operation. The Contractor shall submit for approval

a solar calculation which demonstrates compliance with this requirement. The solar calculation shall include the manufacturer's specified loads of each piece of equipment to be powered. The solar calculation shall take into account the full required operating temperature range.

j. The solar power system shall be designed to operate correctly over a free air temperature range of -30ºF to +122ºF. Solar power system components installed within the control cabinet shall be designed to operate correctly over a temperature range of -30ºF to +165ºF.

k. The VMS control cabinet shall house the batteries and solar power equipment. The equipment shall include, but not be limited to, charge control circuitry that prevents overcharging of the batteries, low voltage disconnect devices which disconnect the batteries to prevent battery damage in the event of a very low state of charge, and an inverter that provides 120 VAC power to the VMS control cabinet. The inverter shall provide 120 VAC power with three (3) percent or less total harmonic distortion, and with output voltage regulation of plus or minus five (5) percent or better. The charge control circuitry shall be temperature compensated such that battery charging voltage is automatically adjusted based on temperature variations to maximize battery life. The control devices shall also include a system monitoring device which allows maintenance personnel to assess critical system parameters such as battery condition and solar panel output. The cabinet shall include overcurrent protection devices that limit overcurrent in the solar power system to safe levels in the event of a malfunction of the solar power system. All conduits entering the cabinet shall be sealed to prevent rodent or other animal intrusion.

l. Where the Contract Documents indicate solar power systems, the solar power control cabinet shall include all provisions for future utility power connection.

m. The VMS control cabinet shall include an AC powered battery charger which, when operating under generator power or utility power, fully recharges the batteries in two (2) days or less, while also supplying power to operate the VMS, VMS controller, VMS control cabinet, and communications device.

n. The solar panels shall be Underwriter's Laboratory (UL) approved. UL certification shall be provided with the catalog cuts and working drawings in the Technical Submittal.

650.06 Testing

The Contractor shall provide testing on all components of the system. The testing shall meet the following requirements:

a. The Contractor shall propose a test plan for the VMS system and for the solar power system and submit the test plan(s) and procedures as detailed herein. Each of the test plans shall contain the following elements:

i. Proposed date, time, and location of the testing
ii. Names and credentials of the Contractor personnel who will be conducting the testing
iii. Descriptive overview of the proposed test procedure

iv. List of test equipment required to perform the testing
v. Test cases and test logging forms which detail every step of the test procedure:

b. Test logging forms shall be presented in tabular format, with separate columns for each of the following:

i. Test case description detailing the test step to be performed.
ii. Expected result
iii. Actual result
iv. Pass/fail
v. Comments

c. The Contractor shall supply separate test logging forms at the time of testing for each test plan, and for each device location. The test logging forms shall show the device location, date, and the start and end times of the test.

d. At the end of each test logging form, there shall be signature and date locations for each of the following:

i. Contractor personnel conducting the test
ii. Engineer representative witness
iii. Authority Resident

e. Signatures on the test logging form will signify only that the test was performed and witnessed, not that it passed or failed.

f. The detailed Test Plans shall be submitted to the Engineer no later than thirty (30) days prior to the beginning of each test phase.

g. The Contractor shall have approved test plans prior to submitting a request to schedule the start of any test activities. The Contractor shall notify the Resident no less than seven (7) days prior to the beginning of any equipment or systems testing.

h. Testing shall provide verification and documentation that all requirements as detailed in this Section and the Plans are met. The Test Plans shall be developed by the Contractor to provide a mechanism that ensures that all contract requirements have been met and tested successfully and verified.

i. If any deviations or changes to the approved Test Plans arise, it shall be resubmitted for review and approval by the Engineer at least fourteen (14) calendar days prior to any planned test activity stage. No tests shall be conducted until the Engineer has approved the test plan.

j. A summary of all tests shall be produced at the completion of each testing phase of the project to ensure that all requirements defined by the system are satisfied.

650.07 Method of Measurement

Variable Message Sign (VMS) Systems will be measured for payment by the lump sum for a fully operational system in place.

VMS Ground Mounted Control Cabinets will be measured for payment by each unit furnished and installed.

VMS Solar Power System will be measured for payment by the lump sum for a fully operational system in place.

The VMS ground mounted control cabinet foundations will be measured in accordance with Section 626.

650.08 Basis of Payment

The accepted quantity of Variable Message Sign (VMS) Systems will be paid for at the Contract lump sum price per location. This price shall be full compensation for furnishing, installing, configuring, and testing associated with the VMS panel and the VMS controller. The price also includes all costs associated with installing, testing, and providing technical support for the wireless radio and antenna. The price also includes all costs associated with the fabrication and installation of the VMS structural steel support including anchorages. The concrete foundations for the VMS support structure shall be paid separately under Item 626.332.

The accepted quantity of VMS Ground Mounted Control Cabinets will be paid for at the Contract unit price for each unit installed. This price shall be full compensation for furnishing and installing the control cabinet, cabinet foundation, and for equipment that uses utility power, for all utility connections, attachments, hardware, meters, disconnects, and associated cabling. The price also includes all costs for associated equipment and hardware within the control cabinet not included in other pay items.

The accepted quantity of VMS Solar Power Systems will be paid for at the Contract lump sum price. This price shall be full compensation for designing, furnishing, installing, and testing associated with the VMS solar power system. The price also includes all costs associated with the structural design and fabrication of the solar panel support systems and the solar panel support foundations.

Payment will be made under:

Pay Item		Pay Unit
650.1011	Variable Message Sign (VMS) System: Route 112 EB	Lump Sum
650.1012	Variable Message Sign (VMS) System: Route 112 WB	Lump Sum
650.2011	VMS Ground Mounted Control Cabinet: Route 112 EB	Each
650.2012	VMS Ground Mounted Control Cabinet: Route 112 WB	Each
650.9011	VMS Solar Power System: Route 112 EB	Lump Sum
650.9012	VMS Solar Power System: Route 112 WB	Lump Sum

SPECIAL PROVISION

SECTION 652

MAINTENANCE OF TRAFFIC

MaineDOT Standard Specification 2014 Edition Section 652 – Maintenance of Traffic and the Maine Turnpike Authority 2016 Supplemental Specification Section 652 – Maintenance of Traffic are deleted in their entirety and replaced with the following:

652.1 Description

This work shall consist of furnishing, installing, maintaining and removing traffic control devices necessary to provide reasonable protection for motorists, pedestrians and construction workers in accordance with these Specifications, the applicable provisions of Section 105.4.5 - Special Detours, and the plans.

Traffic control devices include signs, signals, lighting devices, markings, barricades, channelizing, and hand signaling devices, portable light towers, truck mounted impact attenuators, traffic officers, and flaggers.

652.2 Materials

All traffic control devices shall conform to the requirements of the latest edition of the MUTCD, NCHRP 350 guidelines and all Traffic control devices shall meet Manual for Assessing Safety Hardware (MASH) 16 guidelines if date of manufacture was after December 31, 2019.

All signs shall be fabricated with high intensity fluorescent retroreflective sheeting conforming to ASTM D 4956 - Type VII, Type VIII, or Type IX (prismatic). All barricades, drums, and vertical panel markers shall be fabricated with high intensity orange and white fluorescent retroreflective sheeting conforming ASTM D 4956 - Type VII, Type VIII, or Type IX (prismatic).

Construction signs shall be fabricated from materials that are flat, free from defects, retroreflectorized, and of sufficient strength to withstand deflections using a wind speed of 80 miles/hr.

652.2.2 Signs

Only signs with symbol messages conforming to the design of the Manual of Uniform Traffic Control Devices(MUTCD) shall be used unless the Resident approves the substitution of word messages.

Any proposed use of temporary plaques to cover text or to change text shall be approved by the resident. All signs or proposed plaques shall have a uniform face and be constructed from similar sheeting.

All signs shall be new, or in like new condition and maintained in like new condition throughout the project duration. Signs shall be cleaned just prior to installation and throughout the project utilizing a method that will not damage the reflective sign sheeting.

652.2.3 Flashing Arrow Board

Flashing Arrow Boards must be of a type that has been submitted to AASHTO's National Transportation Product Evaluation Program (NTPEP) for evaluation and placed on the Maine Department of Transportations' Approved Products List of Portable Changeable Message Signs & Flashing Arrow Panels.

Flashing Arrow Boards units shall meet requirements of the current Manual on Uniform Traffic Control Devices (MUTCD) for Type "C" panels as described in Section 6F.56 - Temporary Traffic Control Devices. Flashing Arrow Boards shall have matrix of a minimum of 15 low-glare, sealed beam, Par 46 elements capable of either flashing or sequential displays as well as the various operating modes as described in the MUTCD, Chapter 6-F. If a Flashing Arrow Board consisting of a bulb matrix is used, each element should be recess-mounted or equipped with an upper hood of not less than 180 degrees. The color presented by the elements shall be yellow.

Flashing Arrow Board elements shall be capable of at least a 50 percent dimming from full brilliance. Full brilliance should be used for daytime operation and the dimmed mode shall be used for nighttime operation. Flashing Arrow Board shall be at least 96 inches x 48 inches and finished in non-reflective black. The Flashing Arrow Board shall be interpretable for a distance not less than 1 mile.

Operating modes shall include, flashing arrow, sequential arrow, sequential chevron, flashing double arrow, and flashing caution. In the three arrow signals, the second light from the arrow point shall not operate.

The minimum element on-time shall be 50 percent for the flashing mode, with equal intervals of 25 percent for each sequential phase. The flashing rate shall be not less than 25 nor more than 40 flashes per minute. All on-board circuitry shall be solid state.

Primary power source shall be 12 volt solar with a battery back-up to provide continuous operation when failure of the primary power source occurs, up to 30 days with fully charged batteries. Batteries must be capable of being charged from an onboard 110 volt AC power source and the unit shall be equipped with a cable for this purpose.

Controller and battery compartments shall be enclosed in lockable, weather-tight boxes.

The Flashing Arrow Board shall be mounted on a pneumatic-tired trailer or other suitable support for hauling to various locations, as directed. The minimum mounting height of an arrow panel should be 7 feet from the roadway to the bottom of the panel.

The face of the trailer shall be delineated on a permanent basis by affixing retro-reflective material, known as conspicuity material, in a continuous line as seen by oncoming drivers.

A portable changeable message sign may be used to simulate an arrow panel display.

652.2.4 Other Devices

Vertical panel markers shall be orange and white striped, 8 inches wide by 24 inches high. On the Interstate System, vertical panel markers shall be orange and white striped, 12 inches wide by 36 inches high.

Cones shall be orange in color, a minimum of 28 inches high, and retro-reflectorized. Retro- reflection shall be provided by a white bands of retro-reflective sheeting conforming to the MUTCD. All cones utilized on the project shall be new or in like new condition and shall have a consistent design/appearance.

Drums shall be of plastic or other yielding material and shall be a minimum of 36 inches high and a minimum of 18 inches in diameter. There shall be at least two retro-reflectorized orange and at least two retro-reflectorized white stripes a minimum of 4 inches wide on each drum. All drums utilized on the project shall be new or in like new condition and shall have a consistent design/appearance.

Flaggers shall use a STOP / SLOW handheld paddle as the primary and preferred hand signaling device. Flags shall only be limited to emergencies. STOP / SLOW paddles shall have high intensity prismatic retro reflective sheeting, have an octagonal shape on a rigid handle and shall be at least 18 inches wide with letters at least 6 inches high and shall be constructed from light semi-rigid material. The STOP (R1-1) face shall have white letters and a white border on a red background. The SLOW (W20-8) face shall have black letters and a black border on an orange background.

STOP / SLOW paddles shall also incorporate either white or red flashing lights on the STOP face and white or yellow flashing lights on the SLOW face of the paddle and always be in use.

Paddles must conform to any of the following patterns:

A. Two white or red lights (colors shall be all white or all red), one centered vertically above and one centered vertically below the STOP legend; and/or two white or yellow lights (colors shall be all white or all yellow), one centered vertically above and one centered vertically below the SLOW legend.

B. Two white or red lights (colors shall be all white or all red), one centered horizontally on each side of the STOP legend; and/or two white or yellow lights (colors shall be all white or all yellow), one centered horizontally on each side of the SLOW legend.

C. One white or red light centered below the STOP legend; and/or one white or yellow light centered below the SLOW legend.

D. A series of eight or more small all white or all red lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in an octagonal pattern at the eight corners of the border of the STOP face; and/or a series of eight or more small all white or all yellow lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in a diamond pattern along the border of the SLOW face; or

E. A series of white lights forming the shapes of the letters in the legend. Flashing light patterns shall be compliant with Section 6E.03 Hand Signaling Devices in the most current version of the Manual on Uniform Traffic Control Devices.

All flashing light patterns on the STOP / SLOW paddle shall be visible from a minimum distance of 1000 feet.

Type I barricades shall be 2 feet minimum, 8 feet maximum in length with an 8 inch wide rail mounted 3 feet minimum above the ground. Type II barricades shall be 2 feet in length with two 8 inch wide rails, and the top rail shall be mounted 3 feet minimum above the roadway. Type III barricades shall be 8 feet in length with three 8 inch wide rails, and the top rail shall be mounted 5 feet minimum above the roadway. The cross members of all barricades shall be of ½ or ⅝ inch thick plywood or other lightweight rigid material such as plastic, fiberglass or fiber wood as approved by the Resident. The predominant color for supports and other barricade components shall be white, except that unpainted galvanized metal or aluminum components may be used.

652.2.5 Portable Changeable Message Sign

Portable-Changeable Message Signs (PCMS) will be furnished by the Contractor and shall be Ver-Mac PCMS-1210 or an approved equal. The face of the PCMS trailer shall be delineated on a permanent basis by affixing retro-reflective material, known as conspicuity material, in a continuous line as seen by oncoming drivers. PCMS's shall be located and relocated to locations approved by the Resident within the Project limits for the duration of the Project.

Features to the Ver-Mac PCMS shall include:

- An all-LED display.
- Be legible from a distance of 1,000 feet.
- Have three (3) lines available for messages.
- Be NTCIP compliant (NTCIP 1203 & 1204).
- Be capable of being programmed by a remote computer via a data (IP over Cell) cellular modem connection.
- Have GPS location capability by adding on a GPS device capable of providing GPS location remotely to the MTA Communications' Center.
- Be programmable by Vanguard Software by Daktronics.

The Contractor shall complete and/or provide the following:

- Submit a catalog cut shop drawing to the Resident of all proposed equipment for review and approval.
- Establish and pay for a data cellular account so that PCMS may be remotely programmed and operated from the MTA Communications' Center.

- Provide to the Authority technical support from the PCMS manufacturer that may be necessary to integrate the PCMS into the MTA software platform (Vanguard Software by Daktronics).

- Provide the manufacturer's software necessary to change the PCMS messages remotely from the MTA Communications' Center and the Resident's computer if necessary or requested.

- Provide training on the operation of the PCMS to the Resident and the MTA Communications' Center representative.

- Make all PCMS on the Project work site available to the MTA for any/all emergency situations as defined by the MTA. This shall include the preemption of any messages running at the time of need as approved by the MTA and the Resident.

The Contractor shall also:

- Furnish, operate, relocate and maintain the PCMS as approved or requested by the Resident.

- Be responsible for the day-to-day programming and operation of the PCMS for Project purposes.

The PCMS(s) shall be on-site, with data cellular account established, GPS location capable, and all training required complete within one month after mobilization or seven days prior to implementing traffic shifts, detours or stoppages, whichever is sooner. Implementation of traffic shifts, detours, or stoppages of traffic will not be allowed without PCMS boards on-site with the specified MTA Communications' Center Software Platform integration and training.

652.2.5 Truck Mounted Attenuator

When included in the contract as a pay item, Truck Mounted Attenuator (TMA) requires furnishing, operating, and maintaining one or more Truck Mounted Attenuators for project use. A Truck Mounted Attenuator **shall** be utilized in all lane closures, shoulder closures, and other construction operations on the Turnpike mainline, where work is being completed within the travelway or shoulder and the workers are not protected by other positive means (i.e. closures that do not include temporary concrete barrier). If work is being completed behind guardrail a TMA shall be required for all work that is being completed within the deflection zone of the guardrail (minimum of four feet behind the guardrail post).

The operation of the vehicle shall be in accordance with the Manual of Uniform Traffic Control Devices and the manufacturer's recommendation. If a Truck Mounted Attenuator is not used as described above, then it will be considered a Traffic Control Plan violation and result in a reduction of payment as outlined in Section 652.

The truck mounted attenuator system shall conform to the following requirements:

- Truck and attached attenuator shall conform to the NCHRP Report 350, Test Level 3 criteria or MASH if manufactured after 2019.
- Amber strobe lights with 360-degree visibility.

- An arrow light bar fixed to the vehicle.
- The attenuator shall be mounted to a vehicle with a minimum weight of 10,000 lbs.
- The attenuator shall be mounted to a vehicle with a minimum weight of 24,000 lbs. for Items 652.4501 – Truck Mounted Attenuator – 24, 000 LB.

Installation: The chart below identifies the distance from the work zone or hazard where the TMA shall be deployed. If the work zone is within a marked lane closure, the barrier truck distances shall apply and if the work is mobile, then shadow truck distances shall apply. **The TMA shall be located in the closed lane adjacent to active traffic; for double lane closures, only the outer closed lane requires the TMA.** The TMA shall not be located in the buffer zone. The shadow vehicle shall have its front wheels turned away the work area and from traffic, have parking brake set, and be put in park if an automatic transmission; or if a manual transmission it shall have its front wheels turned away the work area and from traffic, have parking brake set and should be placed in gear and shut off if possible while still maintaining warning lights. If length of time or weather are a concern for the battery since the warning lights must be maintained the engine should be started and run periodically for battery recharging. No other vehicles or equipment shall park in front of the shadow vehicle or within the buffer space behind the shadow vehicle. For placement details, reference the Manual of Uniform Traffic Control Devices (MUTCD).

Weight of Truck	Barrier Truck Distance from Work Zone of Hazard	Shadow Truck Distance from Work Vehicle or Work Zone
10,000 lbs	250 ft	300 ft
15,000 lbs	200 ft	250 ft
>24,000 lbs	150 ft	200 ft

652.2.6 Sequential Flashing Warning Lights

When included in contracts as a bid item Sequential Flashing Warning Lights on drums used for merging tapers and shifting tapers during nighttime operation for project use. The purpose of these lights is to assist the motorist in determining which direction to merge or shift and to reduce the number of late merges resulting in devices being struck and having to be reset to maintain positive guidance at the merge point. The successive flashing of the lights shall occur from the upstream end of the taper to the downstream end of the taper in order to identify the desired vehicle path.

The Sequential Flashing Warning Lights shall meet all of the requirements for warning lights within the current edition of the MUTCD. Each light unit shall be capable of operating fully and continuously for a minimum of 500 hours when equipped with a standard battery set. Each light in sequence shall be flashed at a rate of not less than 55 times per minutes and not more than 75 times per minute. The flash rate and flash duration shall be consistent throughout the sequence.

Sequential Flashing Warning Lights shall be "Pi-Lit" Sequential Barricade Warning Lamps or an approved equal.

Sequential Flashing Warning lights are to be used for merging and shifting tapers that are in place during the nighttime hours (12-hours when ambient light is dimmed). These lights shall flash sequentially beginning with the first light and continuing until the final light at the beginning of a tangent section.

The Sequential Flashing Warning Lights shall automatically flash in sequence when placed on the drums that form the merging or shifting tapers.

The number of lights used in the drum taper shall equal one half the number of drums used in the taper.

Drums are the only channelizing device permitted for mounting the Sequential Flashing Warning Lights.

The Sequential Flashing Warning Lights shall be weather independent and visual obstruction shall not interfere with the operation of the lights.

The Sequential Flashing Warning Lights shall automatically sequence when placed in line in an open area with a distance between lights of 25 to 150 feet. A 10-foot stagger in the line of lights shall have no adverse effect on the operation of the lights.

If one light fails, the flashing sequence shall continue. Non-sequential flashing is prohibited.

652.2.7 Automated Trailer Mounted Speed Sign

When included in the contract as a pay item Automated Trailer Mounted Speed Signs requires furnishing, operating, and maintaining one or more Automated Trailer Mounted Radar Speed Limit Sign for project use. An Automated Trailer Mounted Radar Speed Limit Sign **shall** be utilized wherever there is a Work Zone Speed Limit in place.

If an Automated Trailer Mounted Speed Sign is not used as described above, then it will be considered a Traffic Control Plan violation and result in a reduction of payment as outlined in Section 652.

Trailer mounted speed limit signs shall be self-contained units including sign assembly, flashing lights, directional radar to measure speed limits, a regulatory speed limit sign, and power supply specifically constructed to operate as a trailer-mounted sign. The preferred color of the unit shall be “construction orange”.

Base material for the regulatory speed limit signs shall be weatherproof, rigid substrate specifically manufactured for highway signing and meet the retro-reflective sheeting application requirements of the sheeting manufacturer.

Sign text shall consist of the letters, digits and symbols either applied by stick-on or silk screen, to conform to the dimensions and designs indicated in the Contract, MUTCD and/or FHWA Standard Highway Signs. The materials and methods shall be in accordance with standard commercial processes.

“Work Zone” construction signs shall be mounted on the trailer unit above the regulatory speed limit sign. (see attached graphic details).

Signs and secondary signs shall follow the MUTCD for minimum mounting heights.

The power supply shall be either full battery power with solar panel charging (capable of maintaining a charged battery level) and 135 amperes, 12-volt deep cycle batteries, or diesel powered generator with a fuel capacity sufficient for 10 hours of continuous operation.

Each unit shall be equipped with two mono-directional flashing lights, placed in accordance with the MUTCD, with amber lenses and reflectors, which are visible through a range of 120 degrees when viewed facing the sign. The lights shall be a minimum of 8-inch diameter, either LED, halogen, or incandescent lamps, and shall be visible for a minimum distance of one mile under daylight conditions and shall have a minimum flash rate of 40 flashes per minute. An "On" indicator light shall be mounted on the back of the signs, which is visible for at least 500 feet to provide confirmation that the flashing lights are operating.

The directional radar shall monitor approaching traffic only. The radar shall be capable of measuring speeds from 5 to 70 MPH at a distance of up to 1500 feet and shall have a high speed cut off thresh hold. Speed data shall be recorded and stored on the sign and must be made available to the Authority as requested.

All existing speed limit signs, which conflict with the construction zone trailer mounted speed limit signs shall be covered completely when the work zone speed limit is in place.

The Resident will record the actual time and location for the signs on a daily basis when the Automated Trailer Mounted Speed Limit Signs are in use.

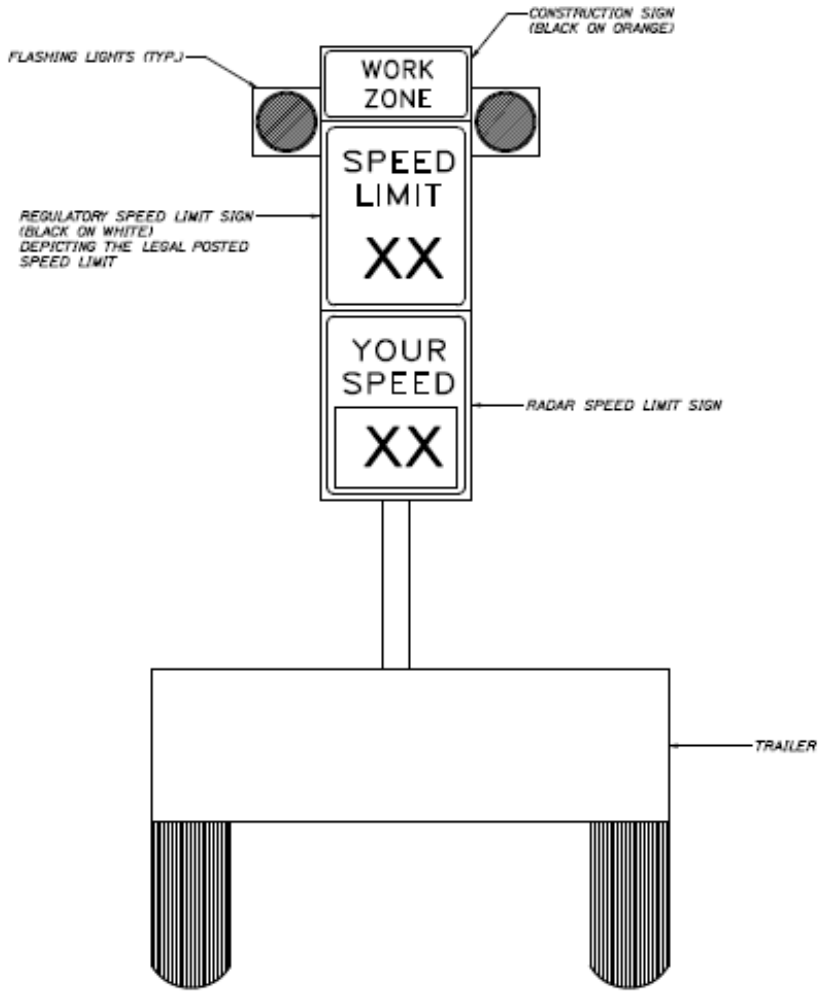
The Automated Trailer Mounted Radar Speed Limit Sign may be placed as shown on the plans, or may replace the posted regulatory speed limit signs, or may be placed at a location within the closed lane that has a reduced speed limit.

Automated Trailer Mounted Speed Limit Signs shall be delineated with retro-reflective temporary traffic control devices while in use and shall also be delineated by affixing a retro-reflective material directly on the trailer.

Upon delivery of the Automated Trailer Mounted Speed Limit Sign and before acceptance by the Authority, the Contractor shall have a representative of the manufacturer review the condition and notify the Resident in writing, of all deficiencies noted.

The Contractor shall arrange to have all necessary repairs performed at no cost to the Authority.

To avoid impairing driver vision, the Contractor shall dim the lighted speed limit readings by 50 percent during nighttime use and restore full power lighting during daytime operation.



Date: 2/13/2018

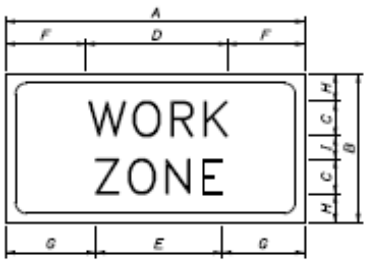
Filename: Trailer Mounted Speed Limit.dgn

HNTB

FEBRUARY 2018

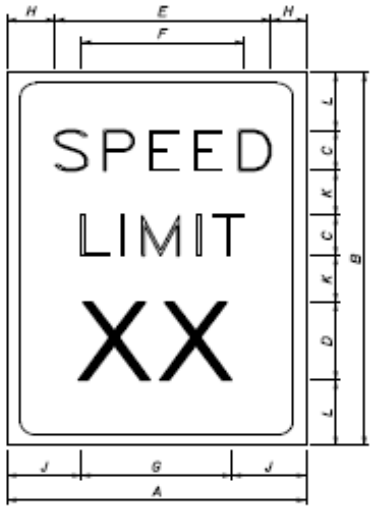
AUTOMATED TRAILER MOUNTED
SPEED LIMIT SIGN

1OF 2



SIGN #1

1.25" BORDER, 0.75" INDENT,
BLACK ON ORANGE; BB GRADE PLYWOOD SIGN



SIGN #2

1.25" BORDER, 0.75" INDENT,
BLACK ON WHITE; BB GRADE PLYWOOD SIGN

	DIMENSIONS (INCHES) / LETTER FONTS											
	A	B	C	D	E	F	G	H	I	J	K	L
#1	48	20	5D	18 1/8	16 5/8	14 1/8	15 5/8	4	2	N/A	N/A	N/A
#2	48	60	8E	16E	38 1/4	29 1/4	29 1/2	4 1/2	9 3/8	9 1/4	8	6

Date: 2/13/2018

Filename: Trailer Mounted Speed Limit.dgn

MAINE TURNPIKE

HNTB

FEBRUARY 2018

TRAILER MOUNTED CONSTRUCTION ZONE
SPEED LIMIT SIGN

2 OF 2

652.2.8 Temporary Portable Rumble Strips

If a pay item is included in the contract or the Contract desires to utilize Temporary Portable Rumble Strips this work consists of furnishing and placing temporary portable rumble strips RoadQuake 2F TPRS or an approved equal. Furnishing a temporary portable rumble strip system includes a method to transport and move these to on-site locations where they will be used. The Contractor shall submit for approval, literature and all necessary certifications to the Maine Turnpike prior to procurement of the product.

If used, Temporary Portable Rumble Strips may not be practicable in areas where the roadway has more than two travel lanes, where volume windows do not allow for breaks in traffic to set up and monitor and adjust, or during nighttime lane closures.

Provide rumble strips where the plans show or as directed by the Resident as follows:

Prior to placing rumble strips, clean the roadway of sand and other materials, that may cause slippage.

Place one end of the rumble strips 6 inches from the roadway centerline. Extend the strips perpendicular to the direction of travel. Ensure strips lay flat on the roadway surface.

Only one series of rumble strips, placed before the first work zone, is required per direction of travel for multiple work zones spaced 1 mile or less apart. Work zones spaced greater than 1 mile apart require a separate series of rumble strips. Each lane shall use one group of temporary rumble strips.

Bracketed “Rumble Strip Ahead” and “Bump” signs shall be utilized and will be paid for under the respective construction sign pay items.

Maintain rumble strips as follows:

If rumble strips slide, become out of alignment, or are no longer in the wheel path of approaching vehicles during the work period, thoroughly clean both sides of the rumble strips and reset on a clean roadway.

Repair or replace damaged rumble strips immediately.

652.3.1 Responsibility of the Authority

The Authority will provide Project specific traffic control requirements and traffic control plans for use by the Contractor. The specific traffic control requirements for the Project are identified in Special Provision Section 652, Maintenance of Traffic (Specific Project Maintenance of Traffic Requirements). No revisions to these requirements or Plans will be permitted unless the Contractor can thoroughly demonstrate an overall benefit to the public and a Contract Modification is approved.

The Maine Turnpike Authority may erect lane closures on the mainline within the Project area to collect survey, provide layout, and for any other reasons deemed necessary by the Authority.

652.3.2 Responsibility of the Contractor

The Contractor shall provide continuous and effective traffic control and management for the Project that is appropriate to the construction means, methods, and sequencing allowed by the Contract and selected by the Contractor:

The Contractor shall ensure all jobsite personnel shall wear a safety vest labeled as ANSI 107-2004 standard performance for Class 3 risk exposures at all times. This requirement also applies to truck drivers and equipment operators when out of an enclosed cab.

652.3.3 Submittal of Traffic Control Plan

The Contractor shall provide continuous and effective traffic control and management for the Project that is appropriate to the means, methods and sequencing allowed by the Contract; and consistent with the Traffic Control Plans and Maintenance of Traffic Specifications. The Contractor is responsible for ensuring a safe environment for the Contract workforce, local road users, and turnpike users; and maintaining the safe efficient flow of traffic through the construction zone at all times during the Contract. The protocols and requirements outlined in the Contract shall be strictly enforced. The Contractor shall submit, at or before the Preconstruction Meeting, a Traffic Control Plan (TCP) that provides the following information to the Authority:

a. The name, telephone number, and other contact numbers (cellular phone, pager, if any) of the Contractor's Traffic Control Supervisor (TCS). The TCS is the person with overall responsibility for ensuring the contractor follows the TCP, and who has received Work Zone Traffic Control Training commensurate with the level of responsibility shown in the requirements of the Contract, and who is empowered to immediately resolve any work zone traffic control deficiencies or issues. Provide documentation that the Traffic Control Supervisor has completed a Work Zone Traffic Control Training Course (AGC, ATSSA, or other industry- recognized training), and a Supervisory refresher training every 5 years thereafter. Submit training certificates or attendance roster that includes the course name, training entity, and date of training. State how the traffic control devices will be maintained including a frequency of inspection for both temporary and permanent traffic control devices.

   Traffic Control Training Course curriculum must be based on the standards and guidelines of the MUTCD and must include, at a minimum, the following:

   1. Parts of Temporary Traffic Control Zone
   2. Appropriate use and spacing of signs
   3. Use and spacing of channelizing devices
   4. Flagging basics
   5. Typical examples and applications

The Traffic Control Supervisor, or designee directly overseeing physical installation, adjustment, and dismantling of work zone traffic control, will ensure all personnel performing those activities are trained to execute the work in a safe and proper manner, in accordance with their level of decision-making and responsibility. The emergency contact list shall contain a listing of individuals who may be contacted during non-work hours and shall adequately respond to the request.

b. Proposed revisions to the construction phasing or sequencing that reasonably minimizes traffic impacts.

c. A written narrative and/or plan explaining how traffic and pedestrians will be moved through the Project Limits, including transitions during the change from one phase of construction to the next, as applicable.

d. Temporary traffic control treatments at all intersections with roads, rail crossings, businesses, parking lots, pedestrian ways, bike paths, trails, residences, garages, farms, and other access points, as applicable.

e. A list of all Contractor or Subcontractor certified flaggers to be used on the Project, together with the number of flaggers which will be used for each type of operation that flagging is needed. If the Contractor is using a flagging Subcontractor, then the name and address of the Subcontractor may be provided instead of a list of flaggers.

f. A procedure for notifying the Resident of the need to change the traffic control plan or the need to remove a lane restriction.

g. A description of any special detours including provisions for constructing, maintaining, signing, and removing the detour or detours, including all temporary bridges and accessory features and complete restoration of the impacted land.

h. The maximum length of requested contiguous lane closure. The Contractor shall not close excessive lengths of traffic lane to avoid moving traffic control devices.

i. The proposed temporary roadway surface conditions and treatments. The Contractor shall provide an adequate roadway surface at all times; taking into account traffic speed, volume, and duration.

j. The coordination of appropriate temporary items (drainage, concrete barriers, barrier end treatments, impact attenuators, and traffic signals) with the TCP.

k. The plan for unexpected nighttime work, the contractor shall provide a list of emergency nighttime lighting equipment and safety personnel available on-site or have the ability to have them on site within an hour of the time of need.

l. The plan for meeting any project specific requirements contained in special provision 105 and/or 107, and/or Section 656

m. The lighting plan if night work is anticipated.

The Authority will review the TCP for completeness and conformity with Contract provisions, the current edition of the MUTCD, and Authority policy and procedures. The Authority will review and provide comments to the Contractor within 14 days of receipt of the TCP. No review or comment by the Authority, or any failure to review or comment, shall operate to absolve the contractor of its responsibility to design and implement the plan in accordance with the Contract, or to shift any responsibility to the Authority. If the TCP is determined by the Authority to be operationally ineffective, the Contractor shall submit modifications of the TCP to the Authority for review and shall implement these changes at no additional cost to the Contract. Nothing in this Section shall negate the Contractor's obligations set forth in Section 110 - Indemnification, Bonding, and Insurance. The creation and modification of the TCP will be considered incidental to the related 652 items.

652.3.4 General

Prior to starting any work on any part of the project adjacent to or being used by the traveling public, the Contractor shall install the appropriate traffic control devices in accordance with the plans, specifications and the latest edition of Manual of Uniform Traffic Control Devices, Part VI. The Contractor shall continuously maintain the traffic control devices in their proper position, and they shall be kept clean, legible and in good repair throughout the duration of the work. If notified that the traffic control devices are not in place or not properly maintained, the Contractor may be ordered to immediately suspend work until all deficiencies are corrected.

No equipment or vehicles of the Contractor, their subcontractors, or employees engaged in work on this contract shall be parked or stopped on lanes carrying traffic, or on lanes or shoulders adjacent to lanes carrying traffic, at any time, except as required by ongoing work operations. Contractor equipment or vehicles shall never be used to stop, block, or channelize traffic.

Vehicles parked on the shoulder shall be located so all portions of the vehicle(s) are a minimum of one foot from the traveled way. No operation shall be conducted on or near the traveled lanes or shoulders without first setting up the proper lane closure and traffic control devices. These precautions shall be maintained at all times while this Work is being performed. The Contractor shall keep all paved areas of the highway as clear as possible at all times. No materials shall be stored on any paved area of the highway or within 30 feet of the traveled way (unless protected by concrete barriers and specifically approved by the Resident). Private vehicles owned by Contractor's employees shall be parked close together in a group no closer than 30 feet from the traveled way in pre-approved areas.

Channelization devices shall include Vertical Panel Markers, Barricades, Cones, and Drums shall be in accordance with the MUTCD. These devices shall be installed and maintained at the spacing determined by the MUTCD through the work area.

The Contractor shall maintain existing guardrails and/or barriers until removal is necessary for construction. The Contractor shall use a temporary barrier or appropriate channelizing devices, as approved by the Resident, while the guardrails and/or barriers are absent. Permanent guardrails and barriers shall be installed as soon as possible to minimize risk to the public.

When Contractor operations or shoulder grading leave a continuous 3 inch or less exposed vertical face at the edge of the traveled way, including the shoulder, or when traffic is shifted into the shoulder adjacent to the edge of pavement where an existing 3 inch or less exposed vertical

face creates a safety hazard, channelization devices should be placed 2 feet outside the edge of the pavement at intervals not exceeding 600 feet and, depending on type and location of the exposed vertical face, a 48 inch by 48 inch W8-9 Low Shoulder, or W8-11 Uneven Lane, and/or a W8-17P Shoulder Drop-Off sign should be placed at a maximum spacing of ½ mile. When Contractor operations or shoulder grading leave greater than a 3-inch exposed continuous vertical face at the edge of the traveled way, including the shoulder, or when an existing condition of an exposed vertical face of 3 inches or more is adjacent to active traffic shifted into shoulder, the Contractor shall place shoulder material at a slope not exceeding 3 horizontal to 1 vertical to meet the pavement grade, before the lane is opened to traffic.

Special Detours and temporary structures, if used, shall meet applicable AASHTO standards, including curve radii and grade.

Maine Turnpike Traffic Control Requirements

This Section outlines the minimum requirements that shall be maintained for working on, over, or adjacent to the Maine Turnpike roadway.

General

Two travel lanes in each direction (each direction being 24 feet wide including/excluding shoulder) in the two lane portion of the turnpike, and three travel lanes in each direction (each direction being 36 feet wide including/excluding shoulder) in the three lane portion of the turnpike (Mile 0.0 to mile 44.3) shall be maintained at all times except while performing work in a designated lane, directly over or adjacent to traffic, and during the placement and removal of traffic control devices.

Unless otherwise specified in the contract documents the minimum main line width for a single travel lane shall be 14 ft and minimum ramp widths of 16 ft which must be maintained at all times, from ½ hour before sunrise and ½ hour after sunset as indicated on the Sunrise/Sunset Table at: http://www.sunrisesunset.com/usa/Maine.asp . If the Project town is not listed, the closest town on the list will be used as agreed at the Preconstruction Meeting.

Shoulder closures, lane closures, and lane shifts meeting the MUTCD guidelines, other than those shown in the plans, must be submitted for approval from the MTA prior to use in the construction operations.

No lane closures will be allowed during non-working hours, weekends and/or holiday periods unless included in the Contract as long-term traffic control requirement as outlined in Section 652 – Specific Project Maintenance of Traffic Requirements unless written permission is obtained from the Authority.

Any special signs, barricades or other devices deemed necessary by the Resident shall be furnished and maintained by the Contractor. Extra care shall be taken so that the traffic flow will not be disturbed. The use of construction signs and warning devices not shown on the Plans or in the MUTCD is prohibited unless approved by the Resident

The Contractor's personnel and equipment shall avoid crossing traffic whenever possible. No Contractor's vehicle may slow down or stop in a traffic lane unless said lane has previously been made safe with signs and barricades as required by the Resident.

No vehicle will move onto the traveled way at such a time or in such a manner so as to cause undue concern or danger to traffic approaching from either direction. The Contractor or his employees are not empowered to stop traffic.

The Contractor shall take necessary care at all times, in all operations and use of his equipment, to protect and facilitate traffic. During periods of idleness, the equipment shall not be left in a way to obstruct the traffic artery or to interfere with traffic.

The Contractor shall furnish approved signs reading “Construction Vehicle - Keep Back” to be used on trucks hauling to the Project. The signs shall be a minimum of 30-inch by 60-inch, Black and Orange, and meet construction sign retro reflectivity requirements

All vehicles used on the Project shall be equipped with amber flashing lights, by means of a single or multiple, flashing LED or strobe lights mounted so as to be visible 360 degrees. In addition, vehicles operating under direction of the Maine Turnpike Authority may be equipped with auxiliary lights that are green, white or amber or any combination of green, white or amber. Auxiliary lighting shall have sufficient intensity to be visible at 500 feet in normal daylight and a flash rate between 1Hz and 4Hz. The vehicle flashing system shall be in continuous operation while the vehicle is on any part of the project and positioned or mounted in such a way to not be obstructed by vehicle mounted or other equipment. Dump trucks, concrete trucks and utility trucks at a minimum shall have a strobe light mounted on each side of the vehicle. The use of motorcycles is not permitted within a construction site or as a means to arrive at or leave a work zone.

Where space is available pavement striping for all tapers shall create a minimum buffer of 250 feet to the point where the temporary concrete barrier taper ends and becomes parallel to the travelway. Temporary concrete barrier shall be tapered at a minimum 8:1 unless space is available and then it should be tapered at 15:1 or 100 feet whichever is longest.

Milling and paving of interchange ramps shall be done between 9:00 p.m. and 5:00 AM, unless otherwise shown on the Maintenance of Traffic Phasing Plans or as directed by the MTA. Only a single ramp at an interchange may be closed at once. Ramp closures will not be permitted the day before or after holidays, on holidays, or on Saturdays or Sundays. The Contractor shall request approval from the Resident/Authority two weeks prior for all ramp closures. Portable changeable message signs shall be used to provide advance notice and warning of the ramp closure. PCMS’s shall be operational a minimum of 1 week prior to ramp closure to notify Patrons. The contractor shall coordinate PCMS locations with the Resident and the MTA.

Access to, and egress from, the construction area shall be with the direction of travel without crossing traffic. Construction vehicles are prohibited from merging with mainline traffic during the AM and PM peak traffic hours unless approved in writing from the MTA. The contractor shall develop work zone access/egress with acceleration and deacceleration areas and should utilize interchange ramp areas whenever feasible.

Temporary Mainline Lane Closures

A lane closure may be required whenever personnel will be actively working within four feet of a travel lane.

Loading/unloading trucks shall not be closer than six feet from an open travel lane. Temporary lane closures will only be allowed at the times outlined in Special Provision, Section 652, Specific Project Maintenance of Traffic Requirements. These hours may be adjusted based on the traffic volume each day by the Resident.

A lane closure is required when a danger to the traveling public may exist. The following is a partial list of activities requiring lane closures. Lane closures may be required for other activities as well:

- Milling and Paving Operations
- Bridge work
- Drainage Installation and/or Adjustment
- Clear Zone Improvements
- Pavement Markings Layout and Placement
- Work directly over traffic within six feet of a travel lane as measured from the painted pavement marking line or traffic control device will require a lane closure. This work includes but is not limited to the following:

    1. Unbolting structural steel
    2. Removing structural steel
    3. Erecting structural steel
    4. Erecting or moving sign panels on bridges or sign structures
    5. Bolting structural steel
    6. Loading and unloading trucks
    7. Light pole removal or installation
    8. Snow fence installation

Lane closures shall be removed if work requiring the lane closure is not ongoing unless included in the Contract as a long-term traffic control requirement or approved by the Resident.

During adverse weather condition when the speed limit on the Maine Turnpike has been reduced to 45 MPH, or during fog or when there is less than ½ mile of visibility, shoulder/lane closures cannot be set up and any currently in place shall be removed. Only work on the turnpike mainline that is behind temporary concrete barrier will be allowed when speed is reduced to 45 MPH or fog/visibility conditions exist.

Daytime lane closures shall be a maximum of three (3) miles. Only one daytime lane closure will be permitted per direction. Nighttime lane closures may extend through the entire length of the Project.

Temporary single lane closures are allowed upon approval of the Resident. Lane and/or ramp closure setup may not begin until the beginning time specified. Closures that are setup early or that remain in place outside of the approved time period shall be subject to a lane rental fee of $1,000 per five minutes for every five minutes outside of the approved time. The installation of the construction signs will be considered setting up the lane closure. Removal of the last construction sign will be considered removal of the closure. Construction signs shall be installed immediately prior to the start of the closure and shall be promptly removed when no longer required. The installation and removal of a closure, including signs, channelizing devices, and arrow boards shall be a continuous operation. The Authority reserves the right to order the removal of an approved closure.

The Authority desires to minimize the number of daytime lane closures and the number of times that a complete stoppage of traffic is required. The Contractor is encouraged to schedule work so that the interference with the flow of traffic will be minimized. Lane closures will not be allowed until traffic associated with complete stoppages of traffic has cleared. Complete stoppages of traffic or lane closures may not be allowed on a particular day if another complete stoppage of traffic has been previously approved for another project.

The Resident is required to receive approval from the Maine Turnpike Authority for all lane closures. The Resident is required to submit a request for lane closures by noon on Thursday for any lane closures needed for the following week. The Contractor shall plan the work accordingly.

Mainline Shoulder Closures

Shoulder closures are anticipated at locations where Contractor access to the mainline is required.

Shoulder closures with plastic drums shall be removed at the end of the workday. Temporary shoulder closures with plastic drums will not be allowed during periods of inclement weather as determined by the Authority.

The location (limits) of shoulder closures with concrete barrier are shown on the Plans. The barrier must be placed prior to the start of the work requiring concrete barrier and shall remain in place until the work activity is complete.

Equipment Moves

The complete stoppage of traffic for an equipment move (including delivery of materials to the median) will be considered for approval if the action cannot reasonably be completed with the erection of a lane closure. Contractor shall be responsible for the installation of Signs CS-3, “Expect Stopped Traffic” and Signs W3-4 “Be Prepared to Stop”, in accordance with the Single Lane Closure Detail immediately prior to the equipment move. Signs will be required on any adjacent ramps within proximity to the stoppage. These signs shall be covered when not applicable.

State Police will be used to stop traffic. Cost for State Police will be the responsibility of the Authority. The times requested for trooper assisted equipment moves by on-duty troopers cannot be guaranteed. The MTA will not be held responsible for any delays or costs associated with the delay, postponement or cancellation of an on-duty trooper assisted equipment move.

The maximum time for which traffic may be stopped and held for an equipment move at any single time shall be five (5) minutes. The duration shall be measured as the time between the time the last car passes the Resident until the time the Resident determines that all travel lanes are clear. The traffic shall only be stopped for the minimum period of time required to complete the approved activity. The Contractor shall reimburse the Authority at a rate of $500 per minute for each minute in excess of the five-minute allowance.

Unapproved movement of equipment or materials across the travel lanes shall be considered a violation of the Maintenance of Traffic Requirements and is subject to a minimum fine of $500 per occurrence with an additional $500 per minute thereafter.

Request for Complete Stoppage of Traffic

A request for a complete stoppage of traffic must be submitted to the Resident for approval. The Resident is required to receive approval from the Maine Turnpike Authority for all stoppages. The request shall be submitted to the Authority by the Resident at least five (5) working days prior to the day of the requested stoppage of traffic and two (2) days for a stoppage less than five minutes. All requests must be received by 12:00 p.m. noon to be considered as received on that day. Requests received after 12:00 p.m. shall be considered as received the following day. The Contractor shall plan the work accordingly.

During the erection or removal of overhead structures or signs traffic shall be stopped and may be held for periods of up to 25 minutes during these operations. Before the roadway is reopened, all materials shall be secured so they will not endanger traffic passing underneath. The Contractor will reimburse the Authority at the rate of $2,500.00 per five-minute period for each roadway not reopened (northbound and southbound), in excess of the 25-minute limit. Total penalty shall be deducted from the next pay estimate.

Blasting of Ledge, The maximum time for which traffic may be stopped at any single time shall be six (6) minutes. This duration shall be measured as the time between the time that the last car passes the Resident, until the time the Resident determines that all travel lanes are cleared of blast debris. The Contractor shall reduce the size of the blast, change the design and method of the blast, use more mats, or otherwise alter the blasting so that the traffic is not stopped for more than six minutes. If, due to the throw of rock onto the highway or other blasting related activities, traffic is stopped for more than six minutes, the Contractor shall pay a penalty of $1,000.00 per minute for every minute traffic is stopped in excess of the six-minute limit. The penalty shall be measured separately on the northbound and southbound roadway (or eastbound and westbound roadway). Total penalties will be deducted from the next pay estimate. Whenever the volume of traffic is excessive such that a six-minute interruption would cause objectionable congestion, in the opinion of the Authority, the hours during which blasting may occur may be further restricted. A detailed blasting plan shall be submitted as required in Supplemental Specific or Special Provision Sections 105 or 107.

652.3.5 Installation of Traffic Control Devices

All traffic control devices shall be in conformance with NCHRP 350 requirements and MASH 16 requirements if manufactured after December 31, 2019 and installed as per manufactures recommendations.

Portable signs shall be erected on temporary sign supports approved crashworthy devices so that the bottom of the sign is either 1) 12 inches or 2) greater than 5 feet above the traveled way. The bottom of all regulatory signs and ramp exit signs shall be a minimum of 5 feet above the traveled way. Post-mounted signs shall be erected so the bottom of the sign is no less than 5 feet above the traveled way, and 7 feet above the traveled way in business, commercial, and residential areas. Post-mounted signs must be erected so that the sign face is in a true vertical position. All signs shall be placed so that they are not obstructed in any manner and immediately modified to ensure proper visibility if obstructed.

The bottom of mainline and ramp traffic control signs intending to remain longer than 3 days, except as provided in 2009 MUTCD Section 6F.03 paragraph 12, shall be mounted 5 feet or greater above the edge of pavement on posts or portable sign supports.

The Resident will verify the exact locations of the construction signs in the field.

Construction signs behind guardrail shall be mounted high enough to be visible to traffic.

Vertical panel markers shall be mounted with the top at least 4 feet above the traveled way.

Drums shall not be weighted on the top. Drain holes shall be provided to prevent water from accumulating in the drums During winter periods, drums shall be placed on the grass shoulder or removed from the roadway so winter maintenance operations will not be impacted. This requires the placement of drums behind the median guardrail. Drums shall not be placed on snowbanks.

The Contractor shall operate and maintain the flashing arrow board unit and for dependable service during the life of the contract. The units shall remain in continuous night and day service at locations designated until the Resident designates a new location or discontinuance of service.

The Contractor shall maintain the devices in proper position and clean them as necessary. Maintenance shall include the covering and uncovering of all signs when no longer applicable (even if for a very short duration). The sign shall be considered adequately covered when no part of the sign face is visible either around or through the covering.

The Contractor shall replace damaged traffic control devices with devices of acceptable quality, as directed by the Resident.

The Contractor is required to cover all existing signs, including regulatory and warning signs, within the Work zone which may conflict with the proposed construction signs. The Contractor is also required to cover all permanent construction signs when they conflict with a daily traffic control setup. The method of covering existing signs must be approved by the Resident. The use of adhesives on the sign face is prohibited.

Work Zone Speed Limits

Work Zone Speed (Fines Doubled) is a regulatory speed limit that indicates the maximum legal speed through a work zone which is lower than the normal posted speed. The speed limit shall be displayed by black on white speed limit signs in conjunction with a black on orange “Work

Zone" plate. Speed limit signs shall be installed at each mile within the work zone. Any existing regulatory speed limit signs within the reduced speed zone shall be covered once the reduced speed signs have been erected.

Two orange fluorescent flags shall be attached to all speed limit signs that are uncovered for a period of time exceeding one week. This work shall be incidental. Signs that are covered and uncovered on a regular basis are not required to have the supplemental flags.

The reduced speed limit signs shall be used when workers are adjacent to traffic, when travel lane(s) are closed, when indicated on Maintenance of Traffic Control Plans provided or other times as approved by the Resident:

The signs shall be covered or removed when not applicable. The covering and uncovering of signs shall be included for payment under Maintenance of Traffic. Signs relating to reduced speed shall be installed in accordance with the details. The Contractor shall note that all signs including those behind concrete barrier or guardrail are required to be clearly visible to all drivers at all times.

Lane Closure Installation and Removal Procedure

The Contractor will follow the following procedures when closing any travel lanes on the turnpike roadways:

1. The sign package shall be erected starting with the first sign and proceeding to the start of the taper. The sign crew shall erect signs with the vehicle within the outside shoulder.

2. Position the arrow board with the proper arrow at the beginning of the taper; and,

3. When arrow board is in place, continue with the drums/cones to secure the work area.

To dismantle the lane closure, start with last drums/cone placed and work in reverse order until all the drums are removed. The arrow board which was installed first shall be the final traffic control device removed, excluding the sign package. The remaining sign package shall be picked-up starting with the first sign placed and continuing in the direction of traffic and with the vehicle in the outside shoulder.

Trucking Plan

The Contractor shall submit a trucking plan to the Resident within 10 working days of the award of the Contract. The trucking plan shall consist of at least the following:

- Date of anticipated start of work per each location.
- Haul routes from plant/pit to work area and return.
- Haul routes from work area to disposal area and return.
- Entering / exiting the work area.

- Vehicle safety equipment and Vehicle inspection.
- Personal safety equipment.
- Communications equipment and plan.

The trucking plan will not be paid for separately but shall be incidental to the Contract.

652.3.6 Traffic Control

The existing travel way width shall be maintained to the maximum extent practical.

Vertical panel markers, drums, cones, or striping shall be used to clearly delineate the roadway through the construction area. Two-way traffic operation shall be provided at all times that the Contractor is not working on the project. One- way traffic shall be controlled through work areas by flaggers, utilizing radios, field telephones, or other means of direct communication.

The traffic control devices shall be moved or removed as the work progresses to assure compatibility between the uses of the traffic control devices and the traffic flow.

Pavement markings shall be altered as required to conform to the existing traffic flow pattern. Repainting of pavement marking lines, if required to maintain the effectiveness of the line, shall be considered incidental to the maintenance of traffic control devices, no separate payment will be made. Inappropriate pavement markings shall be removed whenever traffic is rerouted, and temporary construction pavement markings shall be placed. Removal of non-applicable markings and initial placement of temporary construction pavement markings will be paid for under the appropriate Contract items. Traffic changes shall not be made unless there is sufficient time, equipment, materials, and personnel available to complete the change properly before the end of the workday. This provision will not be required when traffic is rerouted for brief periods and the route can be clearly defined by channelizing devices, or flaggers, or both.

All vehicles used during the installation and removal of traffic control devices, including lane closures, shall be equipped with a vehicle-mounted lighted arrow board or high intensity LED full width light bar acceptable to the Resident. The arrow board or full width light bar shall be capable of displaying a left arrow, right arrow, double arrow, and light bar patterns.

652.4 Flaggers

The Contractor shall furnish flaggers as required by contract documents or as otherwise specified by the Resident. Flaggers shall not stop traffic on Turnpike mainline or interchange ramps. Only State Police are allowed to stop traffic on mainline or interchange ramps.

All flaggers must have successfully completed a flagger test approved by the Maine Department of Transportation and administered by a Maine Department of Transportation approved Flagger-Certifier. All flaggers must carry an official certification card with them at all times while flagging.

For daytime conditions, flaggers shall wear a top (vest, shirt or jacket) that is orange, yellow, yellow-green, or fluorescent versions of these colors meeting ANSI 107-2004, Class 3, along with a hat with 360 ˚ retro-reflectivity.

For nighttime conditions, flaggers shall wear all Class 3 apparel, meeting ANSI 107-2004, including a Class 3 top (vest, shirt or jacket) and a Class E bottom (pants or coveralls), shall be worn along with a hardhat with 360 ˚ retro-reflectivity and shall be visible at a minimum distance of 1000 ft. Flagger stations must be illuminated in nighttime conditions to assure visibility and will be specifically addressed in detail in the Contractor's TCP.

Flagger stations shall be located far enough in advance of the workspace so that approaching road users will have sufficient distance to stop at the intended stopping point. While flagging, the flagger should stand either on the shoulder adjacent to the traffic being controlled, or in the closed lane. At a spot obstruction with adequate sight distance, the flagger may stand on the shoulder opposite the closed sections to operate effectively. Under no circumstances shall the flagger stand in the lane being used by moving traffic or have their back to oncoming traffic. The flagger should be clearly visible to approaching traffic at all times and should have a clear escape route.

When conditions do not allow for proper approach sight distance of a flagger or storage space for waiting vehicles, additional flaggers shall be used at the rear of the backlogged traffic or at a point where approaching vehicles have adequate stopping sight distance to the rear of the backlogged traffic. All flagger stations shall be signed, even when in close proximity. The signs shall be removed or covered when flagger operations are not in place, even if it is for a very short duration.

Flaggers shall be provided as a minimum, a 10-minute break, every 2 hours and a 30 minute or longer lunch period away from the workstation. Flaggers may only receive 1 unpaid break per day; all other breaks must be paid. Sufficient certified flaggers shall be available onsite to provide for continuous flagging operations during break periods. If the flaggers are receiving the appropriate breaks, breaker flagger(s) shall be paid starting 2 hours after the work begins and ending 2 hours before the work ends. A maximum of 1 breaker per 6 flaggers will be paid. (1 breaker flagger for 2 to 6 flaggers, 2 breaker flaggers for 7 to 12 flaggers, etc.). If a flagger station is manned for 10 hours or more, then ½ hour for lunch will be deducted from billable breaker flagger hours.

652.41 Traffic Officers

Local road traffic officers, if required, shall be uniformed police officers. State Police officers and vehicles shall be used to warn and stop traffic on the Maine Turnpike. All State Police shall be scheduled through the Maine Turnpike Authority. The Authority will make payment for the State Police officers and vehicles directly to the State Police.

The Contractor will not be entitled to additional compensation if scheduled Work is not completed due to the unavailability of State Police.

652.5.1 Rumble Strip Crossing

When lane shifts or lane closures require traffic to cross a permanent longitudinal rumble strip for 7 calendar days or less, the Contractor shall install warning signs that read "RUMBLE STRIP CROSSING" with a supplemental Motorcycle Plaque, (W8-15P).

When lane shifts or lane closures require traffic to cross a permanent longitudinal rumble strip for more than 7 calendar days, the Contractor shall pave in the rumble strips in the area that traffic will cross, unless otherwise directed by the Resident. Rumble strips shall be replaced prior to the end of the project, when it is no longer necessary to cross them.

652.6.1 Daylight Work Times

Unless otherwise described in the Contract, the Contractor is allowed to commence work and end work daily according to the Sunrise/Sunset Table at: http://www.sunrisesunset.com/usa/Maine.asp . If the Project town is not listed, the closest town on the list will be used as agreed at the Preconstruction Meeting. Any work conducted before sunrise or after sunset will be considered Night Work.

652.6.2 Night work

When Night Work occurs (either scheduled or unscheduled), the Contractor shall provide and maintain lighting on all equipment, at all workstations, and all flagger stations.

The lighting facilities shall be capable of providing light of sufficient intensity to permit good workmanship, safety, and proper inspection at all times. The lighting shall be cut off and arranged on stanchions at a height that will provide perimeter lighting for each piece of equipment and will not interfere with traffic, including commercial vehicles, approaching the work site from either direction.

The Contractor shall have available portable floodlights for special areas.

The Contractor shall utilize padding, shielding or other insulation of mechanical and electrical equipment, if necessary, to minimize noise, and shall provide sufficient fuel, spare lamps, generators, etc. to maintain lighting of the work site.

The Contractor shall submit a lighting plan prior to any night work for review showing the type and location of lights to be used for night work. The Resident may require modifications be made to the lighting set up in actual field conditions.

Prior to beginning any Night Work, the Contractor shall furnish a light meter for the Residents use that is capable of measuring the range of light levels from 5 to 20 foot-candles.

Horizontal illumination, for activities on the ground, shall be measured with the photometer parallel to the road surface. For purposes of roadway lighting, the photometer is placed on the pavement. Vertical illumination, for overhead activities, shall be measured with the photometer perpendicular to the road surface. Measurements shall be taken at the height and location of the overhead activity.

Night Work lighting requirements:

Mobile Operations: For mobile-type operations, each piece of equipment (paver, roller, milling machine, etc.) will carry indirect (i.e. balloon type) lights capable of producing at least 10 foot- candles of lighting around the work area of the equipment.

Fixed Operations: For fixed-type operations (flaggers, curb, bridge, pipes, etc.), direct (i.e. tower) lighting will be utilized capable of illuminating the work area with at least 10 foot-candles of light.

Hybrid Operations: For hybrid-type operations (guardrail, sweeping, In-slope excavation, etc.), either direct or indirect lighting may be utilized. The chosen lights must be capable of producing at least 10 foot-candles of light around the work area of the equipment

Inspection Operations: Areas required to be inspected by the Authority will require a minimum of 5 foot-candles of lighting. This may be accomplished through direct or indirect means.

The Contractor shall apply 2- inch wide retro-reflective tape, with alternating red and white segments, to outline the front back and sides of construction vehicles and equipment, to define their shape and size to the extent practicable. Pickup trucks and personal vehicles are exempt from this requirement.

The Resident or any other representative of the Authority reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. The Authority shall not be held responsible for any delay in the work due to any suspension under this item.

Failure to follow the approved Lighting Plan will result in a Traffic Control violation.

Payment for lighting, vehicle mounted signs and other costs accrued because of night work will not be made directly but will be considered incidental to the related contract items.

652.6.3 Traffic Coordinator and Personnel

The Contractor shall submit to the Resident for approval a list of traffic control personnel assigned to the Project including qualifications, certifications and experience.

The Traffic Coordinator duties shall include, but are not necessarily limited to:

a. Developing, in conjunction with the Resident and Project superintendent, a traffic control program for the days' work activities which will facilitate traffic in a safe and efficient manner.

b. Ensure that all traffic control implements (signs, arrow boards, barrels, etc.) are on-site so the traffic program can be implemented effectively.

c. Ensure a safe and effective setup or take-down of all signing implements to least impact the traveling motorist; and,

d. Working knowledge of construction signing/traffic control requirements in conformance with the latest issued Manual on Uniform Traffic Control Devices.

e. The Contractor shall supplement the traffic control plan with a daily plan, which includes schedules for utilizing traffic coordinators and flaggers. This plan shall be submitted daily and agreed upon cooperatively with the Resident.

652.7 Method of Measurement

Signs, signs supplied by the Authority, and panel markers will be measured by the square foot for all signs authorized and installed. Flashing arrow boards, portable-changeable message signs, and flashing and steady burn lights, will be measured by each unit authorized and installed on the project. Barricades and cones will be measured by each unit authorized. Drums will be measured by each or as a lump sum authorized and installed, as indicated on the plans and specifications. No additional payment will be made for devices that require replacement due to poor condition or inadequate retroreflectivity.

Flaggers or traffic officers used during the Contract, for the convenience of the Contractor, will not be measured separately for payment, but shall be incidental to the various pay items. This includes use of Flaggers for the delivery of materials and equipment to the project or other Flagger use that is for the Contractor's convenience, as determined by the Resident Engineer. If flaggers are required to maintain traffic and there is not a pay item in the contractor for flaggers, then flaggers shall be incidental to the other Section 652 contract items and no separate payment shall be made.

The accepted quantity of traffic officer and flagger time will be the number of hours the designated station is occupied. The number of hours authorized for payment, if any, will be measured to the nearest ¼ hour.

The Authority will make payment for the State Police officers and vehicles directly to the State Police when utilized for mainline traffic control activities. State Police escorts, if required to move oversize material or equipment loads to the jobsite, will not be paid separately, but shall be incidental to the various pay items.

Maintenance of traffic control devices will be measured by the calendar day or as one lump sum, as indicated in the plans and specifications, for all authorized and installed traffic control devices. Traffic control devices will only be measured for payment the first time used. Subsequent uses shall be incidental to Item 652.36 or 652.361.

The vehicle mounted arrow board, mounted on trucks used for installation and removal of lane closures, will not be measured separately for payment, but shall be incidental to Item 652.36 or 652.361.

The traffic coordinator(s) will not be measured separately for payment but shall be incidental to Item 652.36 or 652.361.

Portable light towers, lighting on equipment and lighting plan will not be measured separately for payment but shall be incidental to the related Contract items.

Truck mounted attenuator shall be measured for payment by the calendar day for each calendar day that the unit is used on a travel lane or shoulder on the project, as approved by the Resident.

Sequential Flashing Warning Lights shall be measured for payment by the maximum number of sequential flashing warning lights satisfactorily installed and properly functioning at any one time during the life of the project. Payment shall include all materials and labor to install, maintain and remove all Sequential Flashing Warning Lights.

Automated Trailer Mounted Speed Limit Sign shall be measured for payment by the calendar day for each calendar day that the unit is used on a travel lane or shoulder on the project or per each for the continued use for the duration of the project. Payment shall include the Trailer, Radar Speed Limit Sign, flashing beacon amber lights, regulatory speed limit sign, fuel, necessary maintenance, and all checking of Radar Speed Limit Signs by manufacturer and all project moves including the transporting and delivery of the unit.

The accepted quantity of temporary portable rumble strips shall be measured by the unit complete in place, per lane closure application. A unit shall consist of 1 group of 3 full-lane width of rumble strips. As shown in the plans, a maximum of 3 units may be used at each lane closure. A unit shall be measured for each group of rumble strips, each time they are used for a lane closure.

652.8 Basis of Payment

The accepted quantity of signs, signs supplied by the Authority, and panel markers will be paid for at the contract unit price per square foot. Such payment will be full compensation for furnishing (or retrieving from the Authority) and installing all signs, sign supports, and all incidentals necessary to complete the installation of the signs.

The accepted quantity of flashing arrow boards, barricades, battery operated flashing and steady burn lights, and cones will be paid for at the contract unit price each for the actual number of devices authorized, furnished, and installed. Such payment shall be full compensation for all incidentals necessary to install and maintain the respective devices.

The Sequential Flashing Warning Lights will be paid for at the Contract unit price per each. This price shall include all costs associated with furnishing, installing, operating, maintaining, relocating, and removing the Sequential Flashing Warning Lights.

The Truck Mounted Attenuator(s) will be paid for at the Contract unit price per calendar day for each TMA used. This price shall include all costs associated with the use of the vehicle. Payment shall include operator, fuel, truck, maintenance, flashing lights, arrow board and all other incidentals necessary to operate the vehicle.

Failure by the contractor to reinstall cones, barrels, signs, covered/uncovered signs, and similar traffic control devices within an hour of them being displaced, moved, knocked over, un-covered and etc. will result in a $150 fine per traffic control device if the issues is not resolved within 1 hour of notification by the resident. An additional $150 will be assessed for each additional hour that the device has not been corrected. If the traffic control device is critical to

the maintenance of traffic creating an actual or potential safety issue with traffic and is not corrected immediately then it will result in a violation letter as described below.

Failure by the contractor to follow the Contracts 652 Supplemental Specifications, Special Provisions and Standard Specification and/or the Manual on Uniform Traffic Control Devices (MUTCD) and/or the Contractors own Traffic Control Plan, or failure to correct a violation, will result in a violation letter and result in a reduction in payment as shown in the schedule below. The Resident or any other representative of the Authority reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. The Authority shall not be held responsible for any delay in the work due to any suspension under this item. Any reduction in payment under this Special Provision will be in addition to forfeiting payment of maintenance of traffic control devices for that day.

Amount of Penalty Damages per Violation		
1st	2nd	3rd & Subsequent
$500	$1,000	$2,500

652.8.1 Maintenance of Traffic Control Devices

Maintenance of Traffic Control Devices will be paid at the contract unit price per calendar day or lump sum price, as indicated in the plans and specifications. Such payment will be full compensation for all days that the Contractor maintains traffic as specified herein, and for moving devices as many times as necessary; for replacing devices damaged, lost, or stolen; and for cleaning, maintaining, and removing all devices used for traffic control, including replacing temporary pavement marking lines.

The contract price for Maintenance of Traffic Control Devices shall be full compensation for all days for such maintenance, encompassing all areas of the contract, regardless of whether or not the work areas or projects are geographically separated.

652.8.2 Other Items

The accepted quantities of flagger hours will be paid for at the contract unit price per hour for each flagging station occupied excluding lunch breaks, and for each approved breaker flagger. Overtime hours, as reported on the certified payrolls, will be paid an additional 30% of the bid price for 652.38. The computation and additional payment for overtime hours will occur during the project close-out process and will be paid as additional hours of 652.38 to the nearest ¼ hour. The contract unit price shall be full compensation for hiring, transporting, equipping, supervising, and the payment of flaggers and all overhead and incidentals necessary to complete the work.

There will be no payment made under any 652 pay items after the expiration of the adjusted total contract time.

The accepted quantities of traffic officer hours will be paid for at the contract unit price per ¼ hour for each station occupied, with no additional payment for overtime. This price shall be full

compensation for supplying uniformed officers with police cruisers, and all incidentals necessary to complete the work, including transportation, equipment, and supervision.

Payment for temporary pavement marking lines and pavement marking removal will be made under the respective pay item in Section 627 - Pavement Markings.

Payment for temporary traffic signals will be made under Section 643 - Traffic Signals.

The accepted quantity of Portable Changeable Message Signs will be paid for at the Contract unit price each. This price shall be full compensation for furnishing, relocating, maintaining and removing the PCMS. The price also includes all costs associated with setting-up and paying for a data cellular account, technical support, training and any costs associated with the GPS location device.

Progress payment of each PCMS shall be pro-rated over the duration of the Contract. Contract duration shall be from the specified Contract start date to substantial completion or Contract completion, whichever is sooner.

For a PCMS that fails to operate when required, the Contractor will be given 24-hours to repair or replace the PCMS. For periods longer than 24-hours, payment will be reduced based on the pro-rated time that the PCMS is out of service.

Drums will be paid for at the contract unit price each, or at the Contract lump sum price, as designated in the Plans and specifications. Such payment shall be full compensation for all drums as shown on the Plans or required to complete the work.

The Truck Mounted Attenuator(s) will be paid for at the Contract unit price per calendar day. This price shall include all costs associated with the use of the vehicle. Payment shall include operator, fuel, truck, maintenance, flashing lights, arrow board and all other incidentals necessary to operate the vehicle.

The Automated Trailer Mounted Speed Limit Sign(s) will be paid for at the Contract unit price per calendar day or per each. This price shall include all costs associated with the use of the Automated Trailer Mounted Speed Limit Sign.

The accepted quantity of temporary portable rumble strips will be paid for at the contract unit price per unit which shall include the transport device. Payment is full compensation for providing, relocating, maintaining or replacing, and removing temporary portable rumble strips. If the pay item is not included in the contract quantities, then the Authority does not anticipate the use of this item on the contract. If contractor wishes to utilize temporary portable rumble strips and the item is not in the contract, then the contractor may propose use of them to the Authority for consideration.

Payment will be made under:

Pay Item		Pay Unit
652.30	Flashing Arrow	Each
652.31	Type I Barricade	Each
652.311	Type II Barricade	Each
652.312	Type III Barricades	Each
652.32	Battery Operated Light	Each
652.33	Drum	Each
652.331	Drum	Lump Sum
652.34	Cone	Each
652.35	Construction Signs	Square Foot
652.351	Construction Signs-Supplied by Authority	Square Foot
652.36	Maintenance of Traffic Control Devices	Calendar Day
652.361	Maintenance of Traffic Control Devices	Lump Sum
652.38	Flaggers	Hour
652.381	Traffic Officers	Hour
652.41	Portable-Changeable Message Sign	Each
652.45	Truck Mounted Attenuator	Calendar Day
652.4501	Truck Mounted Attenuator – 24,000 LB	Calendar Day
652.451	Automated Trailer Mounted Speed Limit Sign	Calendar Day
652.452	Automated Trailer Mounted Speed Limit Sign	Each
652.46	Temporary Portable Rumble Strips	Unit
652.47	Sequential Flashing Warning Lights	Each

SPECIAL PROVISIONS

SECTION 652

MAINTENANCE OF TRAFFIC

(Temporary Pedestrian Barricade – ADA Compliant)

Section 652 of the Standard Specifications shall be amended by the addition of the following:

652.1 Description The Contractor shall furnish, install, and maintain a continuous temporary pedestrian barricade along the pedestrian access route to separate pedestrians from the work zone.

652.2 Materials The temporary pedestrian barricade shall conform to the regulations and guidelines set forth in the Manual on Uniform Traffic Control Devices (MUTCD), Americans with Disabilities Act (ADA), and NCHRP-350.

One of the following Temporary Pedestrian Barricades is considered acceptable for use:

Manufacturer	Product
Pexco Plaistow, New Hampshire 603-382-6533	TPAR Barricade
Plastic Safety Systems Cleveland, Ohio 800-662-6338	SafetyRail ADA-Compliant Pedestrian Barricade
Plastic Safety Systems Cleveland, Ohio 800-662-6338	SafetyWall ADA-Compliant Pedestrian Barricade

652.3.3 Submittal of Traffic Control Plan The Contractor shall submit a Traffic Control Plan (TCP) in accordance with the Standard Specifications and these Special Provisions. The TCP shall include the type of temporary pedestrian barricade proposed, the name, phone number, and address of the manufacturer, and the proposed installation method.

652.7 Method of Measurement Temporary Pedestrian Barricade – ADA Compliant will be measured by the liner foot of barricade installed and ultimately removed.

652.8 Basis of Payment The accepted quantity of Temporary Pedestrian Barricade – ADA Compliant, will be paid for at the contract unit price per liner foot. Such payment will be full compensation for furnishing, installing, maintaining, relocating, and removing the Temporary Pedestrian Barricade and all incidentals necessary to complete the work.

Pay Item		Pay Unit
652.313	Temporary Pedestrian Barricade – ADA Compliant	Linear Foot

SPECIAL PROVISION

SECTION 652

MAINTENANCE OF TRAFFIC

(Specific Project Maintenance of Traffic Requirements)

This Specification describes the specific project maintenance of traffic requirements for this Project.

The following minimum traffic requirements shall be maintained. These requirements may be adjusted based on the traffic volume when authorized by the Authority.

All maintenance of traffic control devices shall meet current MUTCD guidelines and NCHRP 350 guidelines, and MASH guidelines if date of manufacture was after December 31, 2019.

Route 112 Traffic Control Requirements

Two lanes of traffic (one lane in each direction) shall be maintained at all times with the exception of the hours between 7:00 p.m. and 7:00 a.m. Sunday through Thursday nights. During this overnight period, traffic may be reduced to a single lane of alternating one-way traffic. In addition, traffic may be reduced to a single lane of alternating one-way traffic between 9:00 a.m. and 3:00 p.m. Monday through Friday. The maximum length of single-lane alternating traffic shall be 1200 feet.

Route 112 work zone speed limits shall be 25 mph.

Approaches Approach signing shall include the following signs as a minimum. Field conditions may warrant the use of additional signs as determined by the Resident.

Road work Next x Miles
Road work 500 Feet
End Road Work

Work Area At each work site, signs and channelizing devices shall be used as directed by the Resident. Signs include:

Road Work xxxx
One Lane Road Ahead
Flagger Sign

“Road Work Ahead” to be used in mobile operations and “Road Work xx ft” to be used in stationary operations as directed by the Resident.

Other typical signs include:

Be Prepared to Stop
Low Shoulder

Bump
Pavement Ends

The above lists of Approach signs and Work Area signs are representative of the contract requirements. Other sign legends may be required.

A temporary centerline shall be placed each day on all new pavement to be used by traffic. The temporary centerline, when specified of reflectorized traffic paint, shall conform to the standard marking patterns used for permanent markings.

Failure to apply a temporary centerline daily will result in a Traffic Control Violation and suspension of paving operations until temporary markers are applied to all previously placed pavement.

Maine Turnpike Traffic Control Requirements (I-95)

This Section outlines the minimum requirements that shall be maintained for work on, over, or adjacent to the Maine Turnpike roadway. Operations are allowed as outlined below:

Maintenance of traffic plans have been developed for the work shown in the plans. Minimum widths on the Mainline shall be 12 ft lanes and 2 ft shoulders unless otherwise noted. Minimum ramp widths of 16 ft (12 ft lanes and 2 ft shoulders) must be maintained at all times unless otherwise noted.

A maximum of 5,000 LF of temporary concrete barrier may be in place for no more than 45 days when travel lane is less than 4’ from barrier for left shoulder or 8’ from a barrier for a right shoulder.

During milling and paving operations adjacent to mainline lanes, the lane adjacent to the lane being paved shall also be closed.

Mainline work zone speed limits shall be reduced to the following rates:

50 MPH Speed Limit for all paving and milling operations
60 MPH Speed Limit for all other operations.

Work zone speed limits shall only be in place when work is actively occurring in the work zone.

Construction vehicles will not be allowed to cross active ramps. Access to, and egress from, the project site shall be with the direction of travel without crossing traffic.

Equipment moves across ramps will require a short-term ramp closure (i.e. 5-minute maximum timeframe) utilizing State Police and must be approved by the Authority in advance. Ramp closures for equipment moves will not be permitted between 6:00 a.m. and 10:00 a.m. and between 3:00 p.m. and 7:00 p.m. All State Police shall be coordinated through the Maine Turnpike Authority. The Authority will make payment for the State Police officers and vehicles directly to the State Police.

Portable light towers will be required to illuminate the night construction work area.

Mainline Northbound Exit 35 to Exit 36
Project Start to May 19, 2023
September 10, 2023 to May 17, 2024
September 8, 2024 to May 16, 2025
September 7, 2025 to Contract Completion

		Temporary Shoulder Closures	Temporary Lane Closures	Temporary Double Lane Closures
Days of Week:	**Sunday night through Friday morning**			
Time of Day:	8:30 a.m. to 4:00 p.m. 5:00 p.m. to 6:30 a.m. following day	Allowed	Allowed	
Time of Day:	9:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed
Days of Week:	**Friday night through Saturday morning**			
Time of Day:	8:00 p.m. to 6:00 p.m. following day	Allowed	Allowed	
Time of Day:	10:00 p.m. to 8:00 a.m. following day	Allowed	Allowed	Allowed

Mainline Northbound Exit 35 to Exit 36
May 20, 2023 to September 9, 2023
May 18, 2024 to September 7, 2024
May 17, 2025 to September 6, 2025

		Temporary Shoulder Closures	Temporary Lane Closures	Temporary Double Lane Closures
Days of Week:	**Sunday night through Friday morning**			
Time of Day:	7:00 p.m. to 4:00 p.m. 5:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	
Time of Day:	10:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed
Days of Week:	**Friday night through Saturday morning**			
Time of Day:	10:00 p.m. to 8:00 a.m. following day	Allowed	Allowed	
Time of Day:	11:00 p.m. to 7:00 a.m. following day	Allowed	Allowed	Allowed

Mainline Southbound Exit 35 to Exit 36
Project Start to May 19, 2023
September 10, 2023 to May 17, 2024
September 8, 2024 to May 16, 2025
September 7, 2025 to Contract Completion

		Temporary Shoulder Closures	Temporary Lane Closures	Temporary Double Lane Closures
Days of Week:	**Sunday night through Friday morning**			
Time of Day:	6:30 p.m. to 2:00 p.m. following day	Allowed	Allowed	
Time of Day:	9:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed
Days of Week:	**Friday night through Saturday morning**			
Time of Day:	7:00 p.m. to 11:00 a.m. following day	Allowed	Allowed	
Time of Day:	10:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed

Mainline Southbound Exit 35 to Exit 36
May 20, 2023 to September 9, 2023
May 18, 2024 to September 7, 2024
May 17, 2025 to September 6, 2025

		Temporary Shoulder Closures	Temporary Lane Closures	Temporary Double Lane Closures
Days of Week:	**Sunday night through Monday morning**			
Time of Day:	9:00 p.m. to 10:00 a.m. following day	Allowed	Allowed	
Time of Day:	10:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed
Days of Week:	**Monday night through Friday morning**			
Time of Day:	7:00 p.m. to 10:00 a.m. following day	Allowed	Allowed	
Time of Day:	10:00 p.m. to 6:00 a.m. following day	Allowed	Allowed	Allowed
Days of Week:	**Friday night through Saturday morning**			
Time of Day:	8:00 p.m. to 9:00 a.m. following day	Allowed	Allowed	
Time of Day:	11:00 p.m. to 7:00 a.m. following day	Allowed	Allowed	Allowed

SPECIAL PROVISION

SECTION 655

ELECTRICAL WORK

655.01 Description

All work shall be governed by the Standard Specifications except for that work which applies to those sections of the Standard Specifications which are amended by the following modifications, additions and deletions.

Specifically, for the electrical work (in addition to standards specified in individual work sections), the following standards are imposed, as applicable to the work in each instance:

- NEC, National Electrical Code (NFPA No. 70)
- NFPA No. 101, Life Safety Code
- ANSI C 2, National Electrical Safety Code
- ANSI C 73, Dimensions of Attachment Plugs and Receptacles
- NECA standards for installation
- NEMA standards for materials and products
- UL, Underwriters Laboratories

The Contractor will warranty the material supplied by them and their workmanship for a minimum of one (1) year.

655.02 General Provisions

RELATED DOCUMENTS

General provisions of this Contract, including General Provisions and Special Provisions, apply to work of this section.

SUMMARY

This Section specifies several categories of provisions for electrical work, including:

1. Certain adaptive expansions of requirements specified in the Special Provisions.
2. General performance requirements within the electrical systems as a whole.
3. General work to be performed as electrical work, because of its close association.

SUMMARY OF ELECTRICAL WORK

General Outline: The facilities and systems of the electrical work can be described (but not by way of limitation) as follows:

1. Modification of existing electrical service and service/distribution equipment.

2. Installation of electrical control and power distribution systems, including the electrical connections to new equipment.

3. Installation of a stand-by generator including a transfer switch and connections to new equipment.

4. Installation of toll revenue collection systems hardware.

5. Installation of temporary and interim provisions.

Permits and Fees: This work shall include the procurement of and payment for any and all permits and fees required for the performance of the electrical work including those that may be required from local utilities for services.

COORDINATION OF ELECTRICAL WORK

Refer to Part II, Special Provisions for general coordination requirements applicable to the entire work. It is recognized that the Contract documents are often diagrammatic in showing certain physical relationships, which shall be established within the electrical work, and in its interface with other work including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor.

Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of the building construction, and with a minimum of 7'0" overhead clearance where physical limitations permit.

Locate operating and control equipment properly and in accordance with the NEC, to provide easy access, and arrange entire electrical work with adequate access for operation and maintenance.

Coordination of Options and Substitutions: Where the Contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, the Contractor shall not proceed with purchases until coordination of all interface requirements has been checked and satisfactorily established. Substitutions are subject to approval by the Authority or designated representative per the requirements of the Contract documents.

SUBMITTALS FOR ELECTRICAL WORK

For electrical work, submittals are required for each category of items listed below.

- Shop Drawings, Product Data, Certifications, Test Reports, Warranties, Guarantees, Installation Drawings, and Plaza Work Checklist in Appendix I.

- Installation Drawings shall be modified and submitted to reflect any changes during installation of electrical equipment.

The Contractor, prior to forwarding shop drawings and product data to the Resident, shall check all conditions, make all corrections and sign and date each set. No shop drawings will be reviewed by the Resident without the signature of the Contractor, which shall signify that he has checked the submittals.

PRODUCTS, ELECTRICAL WORK

Refer to Divisions 600 and 700 of the Standard Specifications for general requirements on products, materials and equipment. The following provisions expand or modify the requirements as applicable to electrical work:

Compatibility: Provide products, which are compatible with other products of the electrical work and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work.

FLOOR AND WALL PENETRATIONS

Where electrical materials penetrate walls or floors that are a part of a fire separation or assembly, the opening shall be effectively sealed to maintain separation integrity. Openings shall be closed using General Electric RTV850 Silicone RTV Foam, or approved equal to form a fire rated, water-tight seal, and installation with automatic mixing only. The penetration seal materials shall pass ASTM E 814 (UL 1479) Standard Method of Fire Tests for Through Penetration Fire Stops up to the required fire resistance.

Where conduits penetrate a wall, floor or ceiling that is part of a weatherproof barrier, a non-shrink weatherproof type grout and or Sika 1A caulking shall be used, in accordance with manufacturer's installation instructions.

All work, materials, labor to fireproof or waterproof conduit penetrations shall be incidental to the various pay items

EXCAVATING FOR ELECTRICAL WORK

The work of this article is defined to include whatever excavating and back-filling is necessary to install the electrical work. Coordinate the work with other excavating and back-filling in the same area, including de-watering, flood protection provisions, and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), paving, and concrete work. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of installations, excavating and back-filling.

General Standards: Except as otherwise required, comply with the applicable provisions of Divisions 600 and 700 of the Standard Specifications for information related to electrical-work excavating and back-filling. Refer instances of uncertain applicability to the Resident for resolution before proceeding.

ELECTRICAL WORK CLOSEOUT

Construction Equipment: After completion of performance testing and the Authority's performance testing, remove Contractor's tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

ELECTRICAL SYSTEM TEST

The Contractor shall submit certification of the adequacy of each power and/or communications circuit for the following sub-systems, where applicable:

- Lane Controller (LC) System
- Automatic Vehicle Identification (AVI) Readers
- Automatic Vehicle Identification (AVI) Antennas
- Digital Video Audit System (DVAS)
- Traffic Control Pedestal (TCP)
- Vehicle Capture and Recognition System (VCARS)
- Canopy Override Switch (COS)
- Manual Lane Terminal (MLT)
- Receipt Printer (RP)
- Stand-by Generator

Verification of the electrical system should be done by turning on/off assigned circuit breakers prior to attachment of equipment to validate panel schedule and that proper voltage is present at termination.

COMMUNICATIONS SYSTEMS

Provide outlets, wireways, device plates, etc., in conformance with the applicable sections of this specification, as may be required.

Wireways shall be in accordance with "Wireways" part of the Technical Specifications and NEC and the following special conditions:

- Minimum size shall be 1 inch unless otherwise noted.

- No more than two standard factory 90-degree bends per 100 feet or three 90-degree 24-inch radius bends and as to adhere to minimum manufacturers bend radius's on data cables.

655.03 Electrical Wireways

RELATED DOCUMENTS

General provisions of the Contract, including General Provisions and Special provisions, apply to work of this section.

SUMMARY

The requirements of this section apply to electrical wireway work specified elsewhere in these Specifications.

The types of electrical wireways required for the project may include the following:

- Electrical metallic tubing.
- Intermediate metal conduit.
- Liquid tight metallic flexible conduit.
- Galvanized rigid metal conduit.
- Nonmetallic conduit. (PVC)
- Surface Plastic NEMA 4R wireways.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical wireways of types and capacities required, whose products have been in satisfactory use in similar service for not less than three years.

Contractor: A firm with at least three years of successful installation experience on projects with electrical wiring installation work similar to that required for the project. Under this definition, the Contractor can also be a subcontractor to the General Contractor for the Project.

NEMA Compliance: Comply with applicable portions of National Electrical Manufacturers Association standards pertaining to nonmetallic duct and fittings for underground installation.

UL Labels: Provide electrical wireways, which have been listed and labeled by Underwriters Laboratories.

NEC Compliance: Comply with National Electrical Code (NFPA No. 70) as applicable to construction and installation of electrical wireways.

PRODUCT DELIVERY, STORAGE AND HANDLING

Provide color-coded end-cap thread protectors on exposed threads of threaded metal conduit. Handle conduit and tubing carefully to prevent bending and end-damage and to avoid scoring finish. Store pipe and tubing inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, watertight wrapping.

MATERIALS AND COMPONENTS

For each electrical wireway system required, provide a complete assembly of conduit or tubing with fittings including, but not necessarily limited to, connectors, nipples, couplings, elbows,

expansion fittings, supports, and other components and accessories as needed to form a complete system of type required.

Metal Conduit, Tubing and Fittings: Provide metal conduit, tubing and fittings of type, grade, size and weight (wall thickness) required for each service. Where type and grade are not indicated, provide proper selection determined to fulfill wiring requirements, and comply with National Electrical Code for electrical wireways.

Rigid Steel Conduit: FS WW-C-581 and ANSI C80.1.

Intermediate Steel Conduit: FS WW-C-581 and ANSI C80.1.

EMT- Electrical Metallic Tubing: FS WW-C-563A, ANSI C80.3 and UL 797. Installation shall comply with NEC Article 348. Provide high quality, hot dip galvanized, electrical metallic tubing conduit and fittings of type, size and weight (wall thickness) required for each application. EMT shall only be used in enclosed areas that are not subject to possible collision or interference. Where type and grade are not indicated, provide proper selection determined to fulfill wiring requirements, and comply with National Electrical Code. Rain-tight compression type connectors shall be used in all cases. Set-screw type conduit connections or fittings shall not be used.

Galvanized Rigid Metal Conduit Fittings: FS W-F-408, Type and Classes as required.

Liquid-tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit comprised of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside; forming smooth internal wiring channel; with liquid-tight jacket of flexible polyvinyl chloride (PVC).

Liquid-tight Flexible Metal Conduit Fittings: FS W-F-406, Type as required.

Nonmetallic Conduit and Fittings (PVC): Provide nonmetallic conduit and fittings of type, size and weight (wall thickness) required for each service. Where type and grade are not indicated, provide proper selection determined to fulfill wiring requirements, and comply with National Electrical Code for electrical wireways, and with type selected in accordance with applicable standards.

Surface Mounted Plastic NEMA 4R Wireways: Provide wireways for surface mounting as required. Wireways shall be of rectangular cross section of size as required by the National Electrical Code (NFPA No. 70) for conductor fill. Wireways shall be of a design to accommodate wiring devices required.

Conduit and Tubing and Wireway Accessories: Provide conduit, tubing and wireway accessories including straps, hangers, angles expansion and deflection fittings as recommended by conduit, tubing and wireway manufacturers.

Mounting strut materials and hardware: Provide corrosion-resistant hot-dip galvanized strut members and stainless-steel hardware for all equipment and cabinet mounting applications.

INSTALLATION

Install conduit and tubing products as required, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve intended function.

Complete the installation of electrical wireways before starting installation of cables within wireways.

Where conduit is installed in earth, it shall be Polyvinyl Chloride (PVC) conduit as specified in the Plans.

PVC conduit shall be used in concrete slabs on grade and where noted in the Plans. Metallic conduit is not permitted in the concrete slabs or in substitution of any PVC conduit locations specified on the Plans without specific authorization by the Authority.

Wherever possible, install horizontal wireway runs above water and steam piping.

Install surface Plastic NEMA 4R wireways and accessories as required on elevations. Carefully coordinate with interior finishes and furnishings.

End bell fittings shall be installed on all conduit ends.

At any point where a conduit crosses an expansion joint, or where movement between adjacent sections of conduit can be expected, bronze or alloy expansion fittings shall be installed equal to Type AX as made by the O.Z. Electrical Manufacturing Co., Inc., or equivalent by Hope or Spring City unless such locations are within conduit specified as non-metallic. Such locations shall be handled with a non-metallic equivalent or as specified in Plans.

The Contractor shall submit a proposed method of attaching all ancillary components to the toll canopy/mast arm to the Resident for approval. The proposed attachment method shall not require drilling, welding or other attachment methods that will damage the toll canopy/mast arm or its coating. Any areas of galvanized coating that are damaged by the Contractor during installation of ancillary components shall be repaired in accordance with ASTM A780.

655.04 Wires and Connectors

RELATED DOCUMENTS

The general provisions of the Contract, including General Provisions and Special Provisions, apply to the work specified in this section.

SUMMARY

The requirements of this section apply to the wire work specified elsewhere in these Specifications.

The applications for wire and connectors required on the project may include the following:

- Power distribution circuitry.
- Lighting circuitry.
- Appliance and equipment circuitry.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in the manufacture of electrical products of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

Contractor: A firm with at least three years of successful installation experience on projects with electrical wiring installation work similar to that required for the project. Under this definition, Contractor can also be a subcontractor to the General Contractor for the Project.

NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical cable, wire and connectors.

UL Labels: Provide electrical cable, wire and connectors, which have been listed and labeled by Underwriters Laboratories.

NEMA/ICEA Compliance: Comply with National Electrical Manufacturers Association/Insulated Power Cable Authorities Association Standards publications pertaining to materials, construction and testing wire cable, where applicable.

PRODUCT DELIVERY, STORAGE AND HANDLING

Provide factory-wrapped water-proof flexible barrier material for covering wire and cable on wood reels, where applicable; and weather resistant fiberboard containers for factory-packaging of cable, wire and connectors, to protect against physical damage in transit. Do not install damaged cable, wire or connectors; remove from project site.

Store wire and connectors in factory-installed coverings in a clean, dry indoor space which provides protection against the weather.

MANUFACTURERS

Provide products produced by one of the following or approved equal (for each type of cable, wire and connectors):

Cable and Wire:

- Anaconda Wire and Cable Co.
- Belden Corp.
- General Cable Corp.
- Phelps Dodge Cable and Wire Co.
- Wire and Cable Dept., General Electric Co.
- Rome Cable Corp.

Connectors:

- AMP Inc.
- Burndy Corp.
- Minnesota Mining and Mfg. Co.
- OZ/Gedney Co.
- Thomas & Betts Co.

WIRE AND CONNECTORS

Except as otherwise required, provide wire and connectors of manufacturer's standard materials, as required by published product information; designed and constructed as recommended by the manufacturer, and as required for the installation.

Wire:

Provide factory-fabricated wire of the size, rating, material and type as required for each service. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and with NEC standards. Select from only the following types, materials, conductor configurations, insulations, and coverings for 120/208 Volt circuits:

UL Type: THWN. (Sizes #16 AWG wire up to #14 AWG wire)

UL Type: XHHW-2. (Sizes #12 AWG wire up to #2/0 AWG wire)

Material: Copper.

Conductors: (AWG wire 24 to AWG wire 18).

Note: All low voltage signal conductors (including CAT5e and CAT6 data cables) shall be stranded. Conductors for underground, below grade, or in conduit to lane devices shall be shielded and Outdoor (CMX) rated not to be gel filled. Interior building communications cables may be plenum rated for interior wall or cable tray applications.

Concentric-lay-stranded (standard flexibility) (AWG wire 16 and larger).

Interconnection for data communication shall be performed with cables that shall be submitted for approval. The general cable types are designated on the Plans/Specifications. Minimum bend radius should meet the requirements of the manufacturer and the requirements of the system.

Wire shall be color-coded as noted in the wiring schedules provided in the Plans.

Lead-in cables to extend loop detectors shall be IMSA Type 50-2. Loop lead-in cables shall be manufactured with a size of #14 AWG.

Raychem Powergel rated for 600 Volts or approved equivalent shall be used at all loop wire splice locations. All splices must be twisted, soldered and shrink-wrap waterproofed before enclosure is placed.

Home run cables preferably should not be shielded. The use of shielded cable is acceptable provided neither end is grounded.

All cable labeling shall be coordinated with the requirements of the Authority's Toll System Integrator (SI).

INSTALLATION

Install electrical wire and connectors as required, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended functions.

Coordinate cable and wire installation work with electrical wireway and equipment installation work, as necessary for proper interface.

All wire and cable shall be in first class condition when they are installed. Lo-leak lubricants manufactured for the purpose of a pulling lubricant may be used when necessary.

All wires shall be continuous from outlet and there shall be no unnecessary slack in the conductors.

FIELD QUALITY CONTROL

Prior to energizing, check wire for continuity of circuitry and for short circuits with ohmmeter type testing equipment. Correct malfunction when detected.

Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

655.05 Electrical Boxes and Fittings

RELATED DOCUMENTS

The provisions of the Contract, including General Provisions and Special Provisions, apply to the work specified in this section.

SUMMARY

The types of electrical boxes and fittings required for the project may include the following:

- NEMA 4X Cabinet for AVI Readers
- Outlet boxes
- Junction boxes
- Pull boxes

- Floor boxes
- Conduit bodies
- Bushings
- Locknuts

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in the manufacture of electrical units of types and sizes required, whose products have been in satisfactory use in similar service for not less than three years.

Contractor: A firm with at least three years of successful installation experience on projects with electrical installation work similar to that required for the project. Under this definition, Contractor can also be a subcontractor to the General Contractor for the Project.

NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical boxes and fittings.

U.L. Labels: Provide boxes and fittings, which have been listed and labeled by Underwriters Laboratories.

NEMA Compliance: Comply with National Electrical Manufacturers Association standards as applicable to nonmetallic fittings for underground installation.

NECA Standard: Comply with applicable portions of the National Electrical Contractors Association's "Standard of Installation".

MANUFACTURERS

Provide products produced by one of the following or approved equal (for each type of box and fitting):

Control Cabinet:

- Hammond Manufacturing (provided by SI and installed by the Contractor)

Interior Outlet Boxes:

- Appleton Electric Co.
- Arrow Conduit and Fittings Corp.
- National Electric Products Co.
- OZ/Gedney Co.
- Steel City, Midland-Ross Corp.

Junction and Pull Boxes:

- Arrow-Hart, Inc.
- General Electric Co.
- OZ/Gedney Co.
- Square D Co.
- Unitil

Conduit Bodies:

- Appleton Electric Co.
- Crouse-Hinds Co.
- Killark Electric Mfg. Co.
- Pyle-National Co.

Bushings, Knockout Closures and Locknuts:

- Allen-Stevens Conduit Fittings Corp.
- Allied Metal Stamping, Inc.
- Appleton Electric Co.
- Carr Co.
- Raco, Inc.
- Steel City, Midland-Ross Corp.
- Thomas and Betts Co., Inc.

FABRICATED MATERIALS

Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.

Interior Outlet Box Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations. Choice of accessories is Installer's option. All covers for outlet boxes to be stainless steel.

Junction and Pull Boxes: Provide galvanized sheet steel or concrete junction and pull boxes as called for in the Plans with screw-on covers; of the type, shape, and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

Conduit Bodies: Provide galvanized cast-metal conduit bodies, of the type, shape and size, to suit each respective location and installation, constructed with threaded conduit ends, removable cover, and corrosion-resistant screws.

Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable iron conduit bushings of the type and size to suit each respective use and installation.

Mounting strut materials and hardware: Provide corrosion-resistant, hot dipped galvanized members and stainless-steel hardware for all equipment mounting applications. Where strut material is exposed to the weather, and less than 10 feet off the ground, struts shall be stainless steel. When any galvanized strut member or hardware is cut or the galvanizing is compromised, the affected area shall be wire brushed and cleaned to bare metal and the area shall be given two coats of cold galvanizing (following application instructions).

INSTALLATION OF BOXES AND FITTINGS

Install all equipment cabinets in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure the boxes and fittings serve the intended purposes

Install electrical boxes and fittings in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes and fittings serve the intended purposes:

Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

Provide knockout closures to cap unused knockout holes where blanks have been removed.

Locate boxes and conduit bodies to ensure accessibility of electrical wiring.

All boxes shall be rigidly secured in position unless otherwise directed.

Where standard boxes are not suitable, provide boxes of special design to suit space and function.

The Contractor shall submit a proposed method of attaching all ancillary components to the toll canopy/mast arm to the Resident for approval. The proposed attachment method shall not require drilling, welding or other attachment methods that will damage the toll canopy/mast arm or its coating. Any areas of galvanized coating that are damaged by the Contractor during installation of ancillary components shall be repaired in accordance with ASTM A780.

655.06 Wiring Devices

RELATED DOCUMENTS

The general provisions of the Contract, including General Provisions and Special Provisions, apply to the work specified in this section.

SUMMARY

Wiring devices are defined as single discrete units of electrical distribution systems, which are intended to carry but not utilize electric energy.

The types of electrical wiring devices required for this project include the following:

- Receptacles
- Switches
- Wall plates
- Plugs
- Connectors
- Breakers

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of wiring devices, of types and ratings required, whose products have been in satisfactory use in similar service for not less than three years.

Contractor: A firm with at least three years of successful installation experience on projects with electrical installation work similar to that required for the project.

NEC Compliance: Comply with National Electrical Code (NFPA No. 70) as applicable to construction and installation of electrical wiring devices.

UL Labels: Provide electrical wiring devices, which have been tested, listed and labeled by Underwriters Laboratories.

NEMA Compliance: Comply with National Electrical Manufacturers Association standards for general- and specific-purpose wiring devices.

MANUFACTURERS

Provide products produced by one of the following:

- Arrow-Hart, Inc.
- Bell Electric Co.
- Bryant Electric Co.
- Crouse-Hinds Co.
- Cutler-Hammer, Inc.
- General Electric Co.
- Gould, Inc.
- Harvey Hubbell Inc.
- Pass and Seymour, Inc.
- Slater Electric, Inc.
- Square D Co.
- Hunt Electronics
- Lutron
- Intermatic
- Paragon
- Unitil

FABRICATED DEVICES

Provide factory-fabricated wiring devices, in type and electrical rating for the service required.

Receptacles: Comply with NEMA Stds. Pub. No. WD1 and as follows:

General-Duty Duplex: Provide duplex general-duty type, spec. grade, receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 15-ampere, 125-volts, with metal plaster ears, screw terminal connectors, NEMA configuration 5-15R unless otherwise required.

Heavy-Duty Duplex: Provide duplex type, spec. grade, receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, 20-ampere, 125-volts, with metal plaster ears, screw terminal connectors, NEMA configuration L5-20R unless otherwise required.

Switches: Comply with NEMA Stds. Pub. No. WD1 and as follows:

Provide general-duty flush toggle switches, 20-ampere, 120/277 VAC, with mounting yoke insulated from mechanism, equipped with plaster ears, and side-wired screw terminals as follows:

Single pole switches	Double pole switches
Three Way switches	Four Way switches

Breakers: Breakers shall be compatible with existing panel circuits. All breakers necessary will be incidental to the Contract pay items.

WIRING DEVICE ACCESSORIES

Wall Plates: Provide single switch and duplex outlet wall plates for wiring devices, with ganging and cutouts as required, provide with metal screws for securing plates to devices, screw heads colored to match finish of plate, and wall plates possessing the following additional construction features:

Material and Finish: 0.04 inch thick, satin finished stainless steel.

INSTALLATION OF WIRING DEVICES

Install wiring devices where required, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve intended function.

Delay installation of devices until wiring is completed.

Install receptacles and switches only in electrical boxes that are clean and free from excess building materials, debris, etc.

PROTECTION OF WALL PLATES AND RECEPTACLES

Upon installation of wall plates and receptacles, Contractor shall use caution regarding the use of convenience outlets. At time of completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

TESTING

Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements.

655.07 Grounding

SUMMARY

Furnish labor and material to provide grounding facilities for the entire electrical installation as required by all inspecting and jurisdictional authorities as herein specified. The following are included, but not limited to, as items requiring grounding:

- Electrical service neutral conductor.
- Neutral conductor of all transformer secondaries.
- Conduits, boxes and other conductor enclosures. Neutral or identified conductor of interior wiring system.
- Distribution panels, power and lighting panel boards.
- Non-current - carrying parts of fixed equipment, such as transformers, motors, starters, control cabinets, disconnects, lighting fixtures, stand-by generator, etc.
- Metallic cabinets and auxiliary systems cabinets.

EQUIPMENT

Furnish and install all boxes and/or access plates required for installation and inspection of grounding connections to cold water piping system or other made electrodes.

Provide brass identifying tags on all ground clamps.

INSTALLATION

Ground connections made to metallic cold water piping system at such locations as will be readily available for inspection. Provide jumper connections around all meters and shut off devices.

Where cold water piping is not available for ground connections, use other available or made electrodes as described in NEC Section 250.

Conduit Grounding: All grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected internally to the enclosure grounding lug or grounding bus with bare copper conductor. Grounding conductors sized in accordance with NEC shall be used with all grounding bushings.

Equipment Grounding: All electrical equipment shall be grounded. Most other equipment will be furnished with grounding pads or grounding lugs. All ground connections shall be cleaned immediately prior to connection. The Contractor shall provide all grounding material required but not furnished with the equipment.

No grounding conductor shall be smaller than 12 AWG wire unless it is a part of an acceptable cable assembly.

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Installation of Cash Lane Controller Cabinet)

Related Documents

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section, whether or not such work is specifically mentioned in this Section.
B. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

Description

The purpose of this section is to provide information related to the work required to prepare the location for the proposed lane controller (LC) cabinet to be installed by the Contractor. This section provides information on how the work by the Contractor will take the LC into consideration. All work shall be coordinated with the Resident and SI.

Submittals

Five days prior to the installation of the LC cabinet, the Contractor will be required to submit three copies of a neat line sketch of the proposed lane controller cabinet location detailing proposed conduit/wireway runs (calling out conduit/wireway sizes and the specific cables/wires in each conduit/wireway) to the LC, AVI, Sensor loops, TCP, DVAS, MLT, RP, Proximity Reader and COS (As shown in the Plans). Included with this sketch will be the Plaza Work checklist from Appendix I that the Contractor must complete, indicating what cables will be routed into the LC, how much slack is present in each of these cables, and any extra work that is required. The Resident/SI will have three working days to review the submittal. Work done for this submittal will be incidental to mobilization. After this submittal the exact location of the LC installation will be confirmed by the Resident and the SI. Also to be confirmed by the Resident and the SI will be the number, size and location of the conduits entering the LC cabinet, conduit/wireway layouts in pit and entering the pit, canopy and booth, islands, under slabs, etc.

Installation

The Contractor shall install all conduit/wireway and power/data wires, associated with the proposed LC within the LC cabinet so as to be able to connect proposed peripherals to the new LC at the time of installation by the SI.

The Contractor will be required to:

a. terminate clean and dirty power into the LC cabinet or provide alternate termination as directed by the Resident and the SI. Power termination requirements to be confirmed in the field;

b. pull data/power from lane equipment into the LC cabinet with a 36-inch service loop for all data lines (including 120-volt data);
c. label each wire coming into the LC cabinet with numbered tags as directed by the Resident and the SI at the start of the project. Tags shall be neat, legible, waterproof, and approved by the SI/ Resident.

Measurement and payment for preparation work associated with the Lane Controller cabinet as shown on the Plan drawings and described herein will be per each item. Installation of the LC cabinet, installation of receptacles, completion of all conduits and wiring associated with the cabinet shall be incidental.

All new conduit/wireway installed will be paid under its appropriate pay item.

Payment will be made under:

Pay Item		Pay Unit
655.012	Installation of Cash Lane Controller Cabinet	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(DVAS Mount Installation)

Description

The Contractor shall mount a Pelco EM2200 hook to the underside of the toll canopy/mast arm to accept a Costar CHG3000S enclosure for the DVAS camera. The Pelco hook shall be supplied by the SI. The Contractor will be responsible for mounting the hook. The mounting hardware shall be mounted directly to the toll canopy and mast arms. Final location shall be approved by the Authority. Any additional hardware required will be incidental to the pay item.

Basis of Payment

Measurement and payment for work associated with the DVAS mount installation as shown on the Plan drawings and described herein will be per each item.

Payment will be made under:

Pay Item		Pay Unit
655.02	DVAS Mount Installation	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Installation of Sensor Loops)

Description

The Contractor shall sawcut concrete pavement slab as directed by the Resident and according to Plans and detailed manufacturer's instructions provided prior to installation. Given the proprietary nature of the loop installation requirements, the manufacturer's instructions will only be provided to the awarded Contractor. Loop installation will involve multiple sawcuts within the limits indicated on the Plans and per manufacturer provided templates. Templates for loop cutting outlines shall be provided by the SI. No loop installation activities shall be done without the SI representative on-site. The SI will install the sensor loops, provide the required materials for sealing the loops, and terminate the loop sensor wiring using Raychem Powergel rated for 600 Volts provided by the Contractor (see Special Provision Section 655 Electrical Work Subsection 655.04 Wire and Connectors). The Contractor shall be responsible for obtaining and operating required sawcutting equipment. The Contractor shall be responsible for cleaning the saw cut substrate in preparation of the SI installing the loop sensors.

All dust must be contained so that no silica reaches Authority employees or patrons. This may be accomplished by using wet saws, advanced air filter systems or by building an enclosure around the work area. The Contractor shall provide the Resident a 5-day notice prior to any sawcutting activities.

Basis of Payment

Payment to be made as lump sum for all work associated with sawcutting for installation of Sensor loops shown on Plan drawings; including but not limited to, furnishing Raychem Powergel rated for 600 Volts wire connectors for each individual lane sensor. Sawcutting of concrete, removal, and disposal of slurry from wet system sawcutting and substrate cleaning will be incidental to the item.

Payment will be made under:

Pay Item		Pay Unit
655.041	Installation of Sensor Loops – Southbound	Lump Sum
655.042	Installation of Sensor Loops – Northbound	Lump Sum

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Installation of AVI Antennas)

Description

The Contractor shall pick up AVI antennas and mounting equipment at TransCore's warehouse located at 190 Riverside Street, Suite 38 in Portland as coordinated by the Resident. The Contractor shall install antennas and mounts in accordance with the manufacturer's instructions. Antenna wires (LMR 600 Cable) shall be installed, looped, and terminated by the Contractor. If the SI requires additional work during testing the Contractor must be present to assist.

Basis of Payment

Measurement and payment for work associated with the installation of AVI antennas as shown on the Plan drawings and described herein will be per each item. The Contractor will not pay for the purchase of antennas or the AVI equipment SI's presence to tune and test the equipment.

Payment will be made under:

Pay Item		Pay Unit
655.05	Installation of AVI Antennas	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Traffic Control Pedestal (TCP) Preparation Work)

Description

Measurement and payment for preparation work for the TCP as shown on the Plan drawings and described herein will be per each item. Note the procurement of the TCP will be by the SI. The preparation and installation of the TCP shall be performed by the contractor with oversight by the SI. Preparation work shall include furnishing and installing anchor bolts/rods in a pattern provided by the SI and protection of associated wiring for the TCP in advance of installation of the TCP by the contractor. The Contractor shall provide the following items or approved equals for the TCP anchorage system:

- 4 each - 1/2" x 6-1/2" Hilti HAS 304SS threaded rods, nuts (double nut), flat and lock washers.
- 4 each - Hilti HVU adhesive capsules.
- 4 each – 1/2" SS nuts and fender washers for shimming and leveling the pedestal base.

Steps involved for installation of threaded rods are as follows:

1. Using the Pedestal Base or Pedestal Base template provided by the System Integrator, layout and drill four 9/16" holes for the 1/2" threaded rods.
2. Using a compressor and wire brush blow gun, clean out the anchor holes.
3. Use the shop vacuum to clean all concrete dust and metal shavings.
4. For all concrete island installations, install the four ½ inch Hilti HAS 304SS threaded rods (using HVU adhesive capsules according to the manufacturer's instructions).

Final location of TCP and alignment of threaded rod pattern layout shall be confirmed by the Resident and the SI prior to threaded rod installation.

Payment will be made under:

Pay Item		Pay Unit
655.07	Traffic Control Pedestal Preparation Work	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(AWG Wire)

Description

This task shall include the providing and installation of the AWG wire, as described herein for clean and dirty power wiring, for grounding wires (where applicable) and other locations called for in the Plans and Specifications. All wire installed in conduit must be burial grade, suitable for wet locations.

Basis of Payment

Measurement and payment for the installation of the AWG wire as described herein will be per foot, to the nearest 10-foot interval per run. It shall include the furnishing, installation, routing, termination, splices and connection of the wire per the wiring schedule.

Payment will be made under:

Pay Item		Pay Unit
655.101	#6 AWG Wire	Linear Foot
655.1000	#2/0 AWG Wire	Linear Foot
655.102	#2 AWG Wire	Linear Foot
655.11	#10 AWG Wire	Linear Foot
655.12	#12 AWG Wire	Linear Foot
655.13	#14 AWG Wire	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(4pr/24 (Category 5e) Cable)

Description

This task shall include the providing and installation of the Category 5e cable shown on the Plan drawings and described herein.

Cable: 4 pair, 24 AWG, Category 5e, twisted pair cable. Conductor material shall be bare copper, inner jacket material shall be PVC, cable shall be insulated, shielded and non-gel filled. Must be direct burial type suited for harsh conditions 4pr/24 category 5e cable, as approved.

Basis of Payment

Measurement and payment for the installation of the 4pr/24 category 5e cable will be by linear foot to the nearest 10 ft. interval. It shall include the furnishing, installation and routing of the cable per the wiring schedule.

Payment will be made under:

Pay Item		Pay Unit
655.141	4pr/24 (Category 5e) Cable	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(LMR 600 Cable)

Description

This task shall include the providing and installation of the LMR 600 cable shown on the Plan drawings and described herein. The Contractor shall terminate the LMR 600 Cable with the RF Male-RFN-1006-9L2 and RF Female-RFN-1029-2L2 or equivalent. The male terminal end is at the antenna and the female terminal end is at the AVI Reader. The Contractor shall solder the end of the terminal end pins instead of crimping.

Cable: LMR 600 cable, as approved.

Basis of Payment

Measurement and payment for the installation of the LMR 600 cable will be by linear foot to the nearest 10 ft. interval. It shall include the furnishing, installation, routing of the cable per the wiring schedule and terminating.

Payment will be made under:

Pay Item		Pay Unit
655.151	LMR 600 Cable	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Fiber Optic Cable)

Description

This task shall include the providing and installation of 62.5/125 micron multimode fiber optic cable as shown on the Plan drawings and described herein. The following Specifications for the selection and installation of fiber-optic cable and associated hardware are intended to ensure a reliable and consistent fiber optic media infrastructure for the MTA. All fiber optic cable termination and the fiber optic patch panels will be provided by the Contractor. Fiber optic patch panels shall be Corning Pretium or approved equal. All fiber termination and testing shall be completed by a technician certified to perform this work.

Cable: 6-Fiber multi-mode Fi, 100 mbs, 62.5/125 Microns, Outdoor Riser Rated, ST (Male) Connection, as approved

Specifications: Fiber installed must meet or exceed the following Specifications:

- Multimode fiber installed cable shall be 62.5/125micron core/cladding, armored, rodent deterrent, enhanced grade, multimode, and graded index glass fiber. All materials in the cable shall be dielectric.

- Installed fiber must meet or exceed the following performance Specifications:

Wavelength (nm)	Max. Attn.(dB/Km)	Min. Bandwidth (Mhz*Km)
850	3.5	200
1,300	1.5	500

- Plenum rated cable shall be used for all interior installations. Plenum rated cable shall be:

    - Tight buffered 900 um
    - Mechanical strippable Teflon (for plenum applications)
    - EIA/TIA -598 color coding for fiber optic cable
    - Aramid yarn strength member
    - Capable of supporting a short-term tensile load of 310 lb. without stretching.
    - Capable of bend radii as small as 20x outside cable diameter (under installation load) and 10x outside cable diameter (long term load)
    - Capable of a minimum crush resistance of 160 lb./in.

- Optical Cable Corporation D-Series – Rodent Deterrent Riser Rated Distribution Cable shall be used for exterior installations. Cable from other manufacturers will be considered. All cable installed must be approved by the Authority prior to installation.

All cable is to be fully supported throughout its entire run.

At no time shall more than 310 pounds of tension be placed on any fiber cable while it is being pulled through tray or conduit. It is preferred that all fiber cable be pulled with hand power only. If power winches or mechanical advantage devices are used to pull cable, a tensionmeter must be used to ensure that maximum tension is not exceeded. Alternatively, a "mechanical fuse" rated at 300 pounds may be included in the linkage. Torsion shall be avoided with the use of a swivel at the cable end. While under tension, a minimum bend radius of 20 times the outside cable diameter will be maintained through the use of pulleys and sheaves where required. After pulling, no bend may have a radius, at rest, of less than 10 times the outside cable diameter.

Each cable is to be permanently labeled at each end with a unique cable number. In addition, labels shall be affixed to the cable at every transition of a vault, hand hole, riser closet, or major pull box.

Each fiber optic strand shall be labeled with a unique identifier at the ST coupler.

Fiber ends are to be terminated in ST-type connectors. No splices will be permitted. The cable shall be continuous run from building to building and LC to server room fiber switch location.

At each end of the cable, sufficient slack (15 - 30') shall be left to facilitate reasonable future relocation of the fiber switch or LC. Slack shall be mounted on walls or upper ladder racks.

Testing: Contractor shall test all long reels with an OTDR for length and transmission anomalies while on the reel prior to installation. It is suggested that each individual fiber in a cable regardless of length be tested with an OTDR for length and transmission anomalies while on the reel before installation.

All multimode fiber strands shall be tested end-to-end for bi-directional attenuation, 850 nm/1300 nm for multimode. Tests should be conducted in compliance with EIA/TIA-526-14 or OFSTP 14, Method B, according to the manufacturer’s instructions for the test set being utilized.

Tests must ensure that the measured link loss for each strand does not exceed the “worst case” allowable loss defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss of 0.75 dB per mated pair) and the optical loss (based on the performance standard above, 2.1.1 and 2.2.1).

After termination, each fiber shall be tested with an ODTR for length, transmission anomalies, and end-to-end attenuation. Results are to be recorded and supplied to MTA in the form of hard-copy printouts or photographs of screen traces.

After termination each terminated fiber is to be tested for end-to-end loss with a power meter/light source. As above, results are to be recorded and supplied to MTA.

The Contractor shall review all end faces of field terminated connectors with a fiber inspection scope following the final polish. Connector end faces with hackles, scratches, cracks, chips and or surface pitting shall be rejected and repolished or replaced if repolishing will not remove the end face surface defects. The recommended minimum viewing magnifications for connector ends are 100X for multimode fiber.

Basis of Payment

Measurement and payment for the installation of the Fiber Optic cable will be by linear foot to the nearest 10 ft. interval. It shall include the furnishing, installation, termination, testing and routing of the cable per the wiring schedule, as well as furnishing and installation of fiber optic patch panels. Fiber optic patch panels are incidental to the fiber optic cable.

Payment will be made under:

Pay Item		Pay Unit
655.16	6 Strand Multi-Modal Fiber Optic Cable	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(IVIS Homerun Loop Cable (IMSA 50-2 #14))

Description

This task shall include the providing and installation of the IVIS homerun loop cable (IMSA 50-2 #14) shown on the Plan drawings and described herein.

Cable: IMSA 50-2 #14 cable loop detector wire shall be as follows:

- Conductors: Solid or stranded tin copper
- Insulation: Polyethylene
- Conductor Configuration: Twisted pair
- Shield: Aluminum/Mylar tape
- Outer Jacket: Low-density polyethylene

Cable shall have two conductors, #14 AWG, 19-strand. Cable must be direct burial grade suitable for installation in the tunnel, beneath the roadway, within the barrier and any other locations shown on the Plan or described within the design documents. All loop sensor homerun cables shall have tape with length markings.

Basis of Payment

Measurement and payment for the installation of the IMSA 50-2 #14 cable will be by linear foot to the nearest 10 ft. interval. It shall include the furnishing, installation and routing of the cable per the wiring schedule.

Payment will be made under:

Pay Item		Pay Unit
655.17	IVIS Homerun Loop Cable (IMSA 50-2 #14)	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(PVC Conduit)

Description

This task shall include the providing and installation of PVC Conduit as shown on the Plan drawings and described herein. All conduit shall be installed per NEC specification. Connections to specialized fittings are to be compatible with adjoining conduit.

Joints shall be made in accordance with ASTM D 2855. Solvent cement shall meet the requirements of ASTM D 2564 with particular attention to matching the viscosity to the conduit size.

Joint adhesives shall be in accordance with ASTM D2517.

All conduit runs shall be watertight. Slope conduit to drain into junction boxes.

All empty conduits shall have a labeled Mule Tape. Mule Tapes shall have length markings and should be used for long conduits over 50 feet or for all underground installations. Clean, plug and seal conduit ends after installation.

Basis of Payment

Measurement and payment for installing PVC Conduit as shown on the Plan drawings and described herein will be per linear foot of each type of underground or exposed conduit actually furnished, installed, and accepted at the Contract price per linear foot. It shall include the furnishing, installing, supporting and connection of the conduit and all various hardware necessary for the installation. This price shall include the cost of hand digging, trenching, or plowing; furnishing and installing the conduit; furnishing special backfilling materials, Mule Tape, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
655.200	1- 1/2” Schedule 40 PVC Conduit	Linear Foot
655.201	3” Schedule 40 PVC Conduit	Linear Foot
655.2021	1” Schedule 80 PVC Conduit	Linear Foot
655.203	1-1/2” Schedule 80 PVC Conduit	Linear Foot
655.2031	2” Schedule 80 PVC Conduit	Linear Foot
655.204	3” Schedule 80 PVC Conduit	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Galvanized Rigid Metal Conduit (RMC))

Description

This task shall include providing and the installation of Galvanized RMC as shown on the Plan drawings and described herein. All fittings shall be threaded, or approved compression type (approved by the engineer and compatible with the conduit), so as to be waterproof. Conduit shall be installed and grounded per NEC regulations. All supports shall be hot dipped galvanized or stainless steel (approved by the engineer and compatible with the conduit).

Basis of Payment

Measurement and payment for furnishing and installing the Galvanized RMC as shown on the plan drawings, where necessary, and described herein will be per linear foot actually furnished, installed, and accepted at the Contract price per linear foot. This price shall include the cost of furnishing and installing the conduit; Mule Tape, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
655.206	1” Galvanized Rigid Metal Conduit	Linear Foot
655.207	1-1/2” Galvanized Rigid Metal Conduit	Linear Foot
655.2071	2” Galvanized Rigid Metal Conduit	Linear Foot
655.208	3” Galvanized Rigid Metal Conduit	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Liquid Tight Metallic Flexible Conduit)

Description

This task shall include providing and the installation of Liquid Tight Metallic Flexible Conduit as shown on the Plan drawings and described herein. All conduit shall be watertight with flexible PVC coating over galvanized steel flex tubing. Conduit shall be installed and grounded per NEC regulations. All supports shall be hot dipped galvanized or stainless steel. Connections shall be specialized fittings to be compatible with adjoining conduit and watertight.

Basis of Payment

Measurement and payment for installing the Liquid Tight Metallic Flexible Conduit as shown on the Plan drawings and described herein will be per linear foot actually furnished, installed, and accepted at the Contract price per linear foot. This price shall include the cost of furnishing and installing the conduit; Mule Tape, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
655.209	1/2” Liquid Tight Metallic Flexible Conduit	Linear Foot
655.2101	1-1/2” Liquid Tight Metallic Flexible Conduit	Linear Foot
655.2102	2” Liquid Tight Metallic Flexible Conduit	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Installation of Pull Boxes)

Description

This task shall include providing and installing:

- The type A pull box for interior, dry locations as shown on the Plan drawings and detailed herein, or where used elsewhere.
    - Materials: 4" x 4" x 2" Steel; equal to Appleton 4SD1 or better

- The type B pull box for exterior/wet locations as shown on the Plan drawings and detailed herein, or where used elsewhere.
    - Materials: 18" x 18" x 6" NEMA 3R; Galvanized Steel.

- The type C pull box as shown on the Plan drawings and detailed herein. The C pull box shall be installed in booth pits, or building utility pits, or where PVC conduit is used.
    - Materials: 18" x 18" x 6" PVC, NEMA 3R.

- The type D pull box as shown on the Plan drawings and detailed herein, or where used elsewhere.
    - Materials: 16" x 14" x 6" NEMA 4X; Stainless Steel.

- The type E pull box as shown on the Plan drawings and detailed herein. The E pull box shall be installed in booths/buildings in dry locations to pull communications cables, or shown elsewhere on the Plans, or where needed to complete the work.
    - Materials: 6" x 6" x 4" steel, indoor rated; equal to Hoffman A-606CH or better.

- The type F pull box as shown on the Plan drawings and detailed herein. The F pull box shall be installed in booth pits, or building utility pits, or where this size is to be used in a wet location or exterior location.
    - Materials: 4" x 4" x 2" plastic, medium duty; equal to or better than Appleton JIC-2

- The type H pull box as shown on the Plan drawings and detailed herein. The H pull box shall be installed on the toll canopy between conduit runs.
    - Materials: 12" x 12" x 8" NEMA 3R; Galvanized Steel

If equipment is to be installed at a later date, ensure adequate slack in the junction box for termination and an additional 4 inches for possible re-termination. For pass through junction boxes, no slack is required. For specific equipment the following guidelines apply:

- Sensor Loops: A single slack loop of 12" – 24" for convenience of splicing.
- DVAS: Slack loop to allow for distance to mounting location of camera plus an additional 3 feet.
- LC: 4 feet of slack at LC mounting location.

Basis of Payment

Measurement and payment for installing the pull boxes as shown on the Plan drawings and described herein will be per each item. It shall include the furnishing, installation, mounting of the box, and the drilling of holes into the box for conduits.

Payment will be made under:

Pay Item		Pay Unit
655.221	Type A Pull Box Inside	Each
655.2212	Type B Pull Box Outdoor	Each
655.222	Type C Pull Box Inside	Each
655.223	Type D Pull Box Outdoor	Each
655.224	Type E Pull Box Inside	Each
655.225	Type F Pull Box Outdoor	Each
655.227	Type H Pull Box Outdoor	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(36” X 30” X 20” NEMA 4X Cabinet)

Description

Provide and install NEMA 4X stainless steel equipment cabinets as designated on the Plan drawings to house the AVI Readers. The System Integrator will furnish and install the AVI Readers. Cabinets shall provide equipment mounting rails as appropriate with a minimum of two shelves, and shall provide sufficient space for the enclosed equipment. Doors for the equipment cabinets shall be secured with standard interchangeable cylinder locks that match the existing (BEST) system presently in use by MTA. A closed cell neoprene gasket shall be utilized to prevent water entry at the door. A handle controlled latching system shall be included to simplify access to the cabinets. The door shall be able to be opened and closed without need for separate latching hardware. A 120/208-Volt three-phase five-wire circuit shall be furnished and installed for clean and dirty power to a quadplex receptacle (Type 5-15R – half clean/half dirty power - southbound exit toll point will have clean power only) that shall be provided within each cabinet as shown on the Plans. The quadplex receptacles shall be orange/brown with stainless steel cover.

AVI Reader cabinets shall be NEMA-4X with minimum dimensions of:

- Height 36”
- Width 30”
- Depth 20”

AVI Reader cabinets shall be fabricated with internal pieces of aluminum angle that is positioned to support the reader and provide 19-inch-wide rack mounting with minimum depth of 15 inches. The AVI Reader and associated contiguous RF rack height is 21.05 inches. Mounting shall be configured per RS-310 (EIA rack spacing).

Basis of Payment

Measurement and payment for installing the NEMA 4X Cabinets as shown on the Plan drawings and described herein will be per each item. It shall include the furnishing, installation, mounting of the box, and the drilling of holes into the box for conduits. Installation of receptacles and completion of all conduits and wiring associated with the cabinet shall be incidental.

Payment will be made under:

Pay Item		Pay Unit
655.42	36” x 30” x 20” NEMA 4X Cabinet	Each

SECTION 655

ELECTRICAL

(Power and Communications Cabinet)

The following Section is added:

655.01 Description

This task shall consist of installing a new power and communications cabinet provided by the Contractor on a new concrete foundation as shown on the plans or described herein. The cabinet shall be installed at the SB exit lane toll points.

The cabinet shall include two, 36-inch x 36-inch x 4-inch concrete work pads, or one, 36-inch-wide pad that is equal in width to the cabinet and shall be installed in front and back of the cabinet, at each set of doors. The pad shall be placed on a minimum of four inches of compacted granular material. The pad shall be set with at least one percent grade such that any water on the pad shall flow away from the cabinet. The cabinet shall be secured to the concrete foundation provided by the Contractor as shown in the Contract Documents. Where the work pad is installed on a slope, the depth of the pad shall be increased such that there is at least two inches of the concrete pad below grade.

655.02 Materials

The new power and communications cabinet shall be a NEMA 3R - Safetran model 342 LX with extension base or approved equal.

a. The cabinet shall protect the electronics and interfaces against sustained winds of 90 miles per hour (MPH), with 120 MPH wind gusts, blowing sand and dust, roadside pollutants from vehicle exhausts, blowing rain and snow and heavy ice accumulations experienced in the project area.
b. The cabinet doors shall be supplied and installed with Corbin 1548-1 locks for access by #2 keys.
c. The cabinet shall be supplied with captive door restraint bars. The bars shall allow the doors to be kept open at a minimum of two different angles with one at 90 degrees and the other in the fully open position. The door restraint bars shall be supplied and installed such that the doors are held in place during a 40 MPH wind without the restraint bar being bent. The door restraint bars shall be provided to prevent door movement when open in windy conditions.
d. Door hinges shall be continuous and bolted to the cabinet and door utilizing steel carriage bolts and nylock nuts. The hinges shall be made of a minimum 0.083-inch thick aluminum and shall have a minimum 0.250-inch diameter stainless steel hinge pin. The hinge pin shall be capped at the top and bottom by a weld to prevent removal.
e. The top and bottom of the latching pushrods shall contain nylon rollers to promote secure door closure.
f. The door handle shall be stainless steel. The latching handle shall have provisions for padlocking in the closed position.
g. The power and communication cabinet shall be covered by a one year dated warranty

covering material defects for one year from date of acceptance.

h. The cabinet shall contain a power switch mounted within the cabinet to control power to all duplex outlets. The cabinet shall include a minimum of two duplex outlets (total of four outlets), each rated for 15 amps.
i. The Contractor shall supply and install a thermostatically controlled electric fan in the cabinet to maintain the temperature within the field cabinet to that required by the equipment for outside temperatures as specified in these Special Provisions. Thermostats shall have the capability of being field adjusted from 50° F to 120° F.
j. All exposed, high voltage electrical terminals shall be insulated with non-conducting material such as rubber boots or silicon/rubber caulking.
k. The cabinet shall be electrically bonded to all of its associated metallic toll mast arm support structure grounding systems, as described elsewhere in this document or in the Contract Documents.
l. All air venting arrangements shall contain air filters. The air filters shall have an average rated efficiency of 30% and an arrestance of 90% when tested in accordance with ASHRAE 52.1-1992 Test Standard. The filter shall be listed and rated Class 2 by the Underwriters Laboratories. Each cabinet shall be supplied with all required air filters. All fans shall be located above the air filters at the top of the cabinet.
m. All intake and exhaust vents shall meet NEMA 3R requirements with and without powering the air venting arrangements. All exhaust vents shall be furnished with a screen to prevent insects from entering the cabinet.
n. The cabinet shall have an internal LED light located in the top of the cabinet inside the door. This light shall automatically turn on when the cabinet door is open and shut off when the door is closed. The light shall be hardwire connected to the cabinet's electrical power distribution buss.
o. The cabinet shall contain a three phase 60 AMP 12 space clean power panel sub panel for toll equipment.
p. The cabinet shall contain a fiber optic patch panel for toll communication.

655.05 Measurement of Payment

New power and communications cabinet will be measured by each unit.

655.06 Basis of Payment

The accepted quantity of Power and Communications Cabinet will be paid for at the contract unit price each. The unit price shall include the cabinet, a new reinforced concrete foundation, installing the new cabinet on the new foundation, concrete work pads and all incidentals required to complete the work as shown on the plans or described herein.

Payment will be made under:

Pay Item		Pay Unit
655.421	Exit Toll Power and Communication Cabinet	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(PVC Conduit Condulets)

Description

This task shall include the installation of PVC condulets where called for on the plans, or where called for on installation drawings. Fittings for PVC condulets are to be joined using couplings and approved solvent, as recommended by the manufacturer. Types of condulets include, but are not limited to “LB”, “T”, “LR”, “LL”. All openings shall have rubber gaskets.

Basis of Payment

Measurement and payment for installing the PVC condulets as described herein will be per item. It shall include the furnishing, installation and mounting of the condulet, and all associated hardware.

Pay Items are as follows:

Pay Item		Pay Unit
655.501	1” PVC Conduit Condulets	Each
655.502	1½” PVC Conduit Condulets	Each
655.503	2” PVC Conduit Condulets	Each
655.504	3” PVC Conduit Condulets	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Rigid Metal Conduit Condulets)

Description

This task shall include the installation of Rigid Metal Conduit Condulets where called for on the plans, or where called for on installation drawings. The condulets shall be hot dipped galvanized and waterproof, with threaded couplings or approved compression type couplings (if recommended by the manufacturer and compatible with adjoining conduit). Types of condulets include, but are not limited to "LB", "T", "LR", "LL". All openings shall have rubber gaskets.

Basis of Payment

Measurement and payment for installing the condulets as described herein will be per item. It shall include the furnishing and installation and of the condulet, and all associated hardware.

Pay Items are as follows:

Pay Item		Pay Unit
655.512	1" Rigid Metal Conduit Condulets	Each
655.513	1½" Rigid Metal Conduit Condulets	Each
655.514	2" Rigid Metal Conduit Condulets	Each
655.515	3" Rigid Metal Conduit Condulets	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Plastic Wireway)

Description

This task shall include the providing and installation of plastic wireway in the booth pit as shown on the Plan drawings and/or described herein. Wireways shall be plastic NEMA 4X and shall be installed per NEC regulations. All supports for wireways shall be stainless steel.

Basis of Payment

Measurement and payment for installing the Plastic Wireways as shown on the Plan drawings and described herein will be per foot, to the nearest two-foot increment above the final installed segment. It shall include the furnishing, installing, supporting and connection of the wireway and all misc. Hardware necessary for the installation. It shall also include all end caps, covers, drilling of holes for conduits, fabrications for 90-degree bends, etc.

Payment will be made under:

Pay Item		Pay Unit
655.63	4-inch x 4-inch Plastic NEMA 4X Wireway	Linear Foot
655.64	6-inch x 6-inch Plastic NEMA4X Wireway	Linear Foot

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Lightning Suppression System)

655.81 Description

This task shall include furnishing and installing the lightning suppression system as described in the Plan drawings and described herein. Drawings and general provisions of this Contract, including General Provisions and Special Conditions, apply to work of this Section.

The task also includes obtaining a UL Master Label Certificate for the completed lightning suppression system as a UL Class I ordinary structure.

655.82 Submittals

1. Product Data: For air terminals and mounting accessories, grounding conductors, grounding electrodes, and ground connection equipment.

2. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

3. Qualifications: Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.

4. Inspection: Field inspection reports indicating compliance with UL Master Label Certification.

655.83 Quality Assurance

1. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer. Installer shall be UL listed as a lighting protection installer.

2. Listing and Labeling: All system components utilized in the installation shall comply with the Standard for Lightning Protection Components, UL 96A.

655.84 Coordination

Coordinate installation of lightning protection with installation of other tolling systems and components, including electrical wiring, supporting structures and materials, metal bodies requiring bonding to lightning protection components, and finishes.

655.85 Products

Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

1. Automatic Lightning Protection.
2. ERICO International Corporation.
3. Harger Lightning Protection, Inc.
4. Heary Bros. Lightning Protection Co. Inc.
5. Independent Protection Co.
6. Robbins Lightning Inc.
7. Thompson Lightning Protection, Inc.

Air Terminals shall be NFPA Class I, solid copper, 3/8" diameter, by 24" tall or 10" tall, as indicated on the Contract Drawings. Main roof conductors as down conductors shall be bare copper in sizes as indicated on the Contract Drawings. Grounding electrodes shall be copper-clad steel, 3/4" diameter by 10'-0" long.

Provide a UL 1449 compliant, Type 1 surge suppression device at the new main service panelboard in the Utility Shed. The device shall be as manufactured by *Eaton*, series SP2-240, or approved equal. The surge suppression device shall have a minimum nominal discharge rating of 20kA and shall be listed on the UL Certification Directory for Type 1 surge protection devices.

655.86 Execution

All work shall conform to the requirements contained in the latest edition of UL 96A, Installation Requirements for Lightning Protection Systems, and in the latest edition of NFPA 780 Standard for the Installation of Lightning Protection Systems.

Install conductors with direct paths from air terminals to ground connections. Conductors shall be supported for their entire length without travel through free air. No bend of a conductor shall form an included angle of less than 90 degrees or have a radius of bend less than 8 inches.

Conductors shall not be directly attached to aluminum or galvanized steel. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

Main conductors shall be fastened at intervals not exceeding 3 feet.

Down conductors shall be installed within Schedule 80 PVC conduit for physical protection.

Cable Connections: Use UL listed connectors or approved exothermic-welded connections for all conductor splices and grounding connections.

UL Inspection: Provide inspections as required to obtain a UL Master Label Certification for the system.

LPI Certification: Provide an inspection by an inspector certified by LPI to obtain an LPI certification for the system.

655.87 Method of Measurement

Lightning Suppression Systems will be measured by each lightning suppression system shown on the plans.

655.88 Basis of Payment

The accepted quantity of Lightning Suppression System will be paid for at the Contract unit price per each which shall include excavation, air terminals, grounding rods, heavy duty ground test wells with cover, copper wire, associated hardware for a complete operational system, and system certification.

Payment will be made under:

Item	Description	Unit
655.801	Lightning Suppression System – Southbound Entry and Exit	LS
655.802	Lightning Suppression System – Northbound Entry and Exit	LS

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Key Switch)

Description

A key switch similar to existing key switches in use within the toll system shall be installed in line between the clean power panel and power lead for each pair of VES cameras and each DVAS camera.

Basis of Payment

Work shall include furnishing all materials, hardware, equipment, and labor to install key switch. All conduit and wires will be paid under separate pay items.

Payment will be made under:

Pay Item		Pay Unit
655.81	Key Switch	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL

(Receptacle Boxes)

Description

A convenience duplex outlet of NEMA type 5-15R may be required near new cash lane controllers at a location to be determined by the Resident and the SI and in new toll booths. Covers shall be stainless steel.

A Quadplex receptacle of two NEMA type 5-15R may be required near new cash lane controllers at a location to be determined by the Resident and the SI and in new toll booths. Covers shall be stainless steel.

Basis of Payment

Work shall include furnishing all materials, hardware, labor, and equipment to install. All conduit and wires will be paid under separate pay items.

Payment will be made under:

Pay Item		Pay Unit
655.82	Duplex Receptacle	Each
655.84	Quadplex Receptacle	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL WORK

(LED Canopy Light Fixture)

655.01 Description

This work shall consist of furnishing and installing (2) new LED light fixtures with housing per lane in the new toll plaza canopy in accordance with these Specifications, and as shown on the Plans or as approved by the Resident.

655.011 General

The Contractor shall submit a shop drawing for installing new LED fixtures for approval.

655.02 Materials

Provide products produced by:

- CREE Inc. – BetaLED 304 Series – PKG-304-40-DM-06-E-UL-BZ-350-J-40K or approved equal

655.03 Method of Measurement

LED light fixtures will be measured by each unit, installed, and accepted.

655.04 Basis of Payment

LED Canopy Light Fixtures will be paid for at the Contract unit price each which payment shall be full compensation for furnishing and installation of the new fixture, and all other materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Unit
655.92	LED Canopy Light Fixture	Each

SPECIAL PROVISION

SECTION 655

ELECTRICAL WORK

(LED Bumper Beacon)

Description

This work shall consist of furnishing and installing one (1) new LED yellow flashing signal head on the center of the front cash lane bumper (surfaced mounted) per lane in the toll plaza cash lanes in accordance with these Specifications, and as shown on the Plans or as approved by the Resident.

General

The Contractor shall submit a shop drawing for installing new LED fixtures for approval.

Materials

Provide the following products per cash lane Bumper Beacon:

- Single section traffic signal 12" housing – Federal Yellow (Black Face), polycarbonate – McCain or equal
- Standard 12" signal tunnel visor – Federal Yellow exterior / Black interior, polycarbonate – McCain or equal
- Dual Circuit Mushroom Flasher unit (1 NB and 1 SB)- Federal Yellow – McCain or equal
- Single 12" LED yellow signal 120V – GE GTx LED Signal Module or equal

Method of Measurement

LED Bumper Beacon will be measured by each unit, installed, and accepted.

Basis of Payment

LED Bumper Beacon will each be paid for at the Contract unit price. Payment shall be full compensation for furnishing and installation of the new Bumper Beacon, and all other materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Unit
655.99	LED Bumper Beacon	Each

SPECIAL PROVISION

SECTION 670

SEWAGE DISPOSAL SYSTEM

(Sewage Disposal System - Southbound)

The following Section is added:

670.01 Description

This work shall consist of construction of a gravity feed subsurface wastewater disposal system to serve the Southbound Toll Administration Building. The work shall include furnishing and installing all materials required for proper construction of the proposed subsurface wastewater disposal system as designed and noted in Appendix B This includes piping, proprietary-type distribution system (chambers, piping, fittings, adapters, etc.), septic tank, and suitable fill materials. The work shall also include all testing and all other work necessary to complete the construction, all in accordance with these Specifications and as shown on the Plans and as detailed in the State of Maine Subsurface Wastewater Disposal Rules, dated August 3, 2015 (Rules).

All materials, construction methods and details, and approvals shall conform to these Specifications, the Rules, Maine Plumbing Code and all other applicable State and Local Laws and Ordinances.

Before beginning work, the Contractor shall verify that all site conditions and elevations that will have a bearing on the work are as shown on the Plans. If any discrepancies are found, the Contractor shall notify the Maine Turnpike Authority (MTA) immediately.

Before any portion of the work can be backfilled, the Contractor shall make arrangements to have the Local Plumbing Inspector (LPI) inspect the work. Backfilling shall proceed pursuant to approval of the work by the LPI.

The contractor will coordinate work with that of all other trades affecting, or affected by work of this Section. They will also cooperate with such trades to assure the steady progress of all Project work.

670.02 Submittals

Shop and working drawing submittals shall include details of all piping, pipe fittings, subsurface disposal system materials, precast concrete structures and details of interfaces, connections, dimensions, layouts and other pertinent data, including:

Certificates of Compliance for all pipe and precast concrete structures.

670.03 Pipe and Fittings

Gravity sewer pipe (solid), joints and fittings shall comply with Section 6M of the Rules.

Concrete chambers, distribution piping, fittings, and adapters for the disposal field shall be as an approved equal as determined by the septic system design and as approved by the Rules.

670.06 Special Fill for Disposal Bed

Soil fill material beneath, above and adjacent to the concrete chamber system, including fill extensions, shall meet the requirements of the Rules.

670.7 Insulation

Thermal insulation for the top of the distribution box shall be rigid cellular polystyrene in accordance with ASTM C578, Type VII, a minimum two inches thick.

670.8 Bedding Material

Bedding material for pipe and structure subgrades shall be gravel borrow per Subsection 703.20 of the Standard Specifications, except that the largest size particle shall be two inches.

670.09 General Construction

Maintain all excavations in proper condition for carrying on the work, and performing all bailing, draining, or pumping as necessary to keep the excavation free of water.

It shall be the Contractor's responsibility to obtain all necessary permits and pay all fees at no additional cost to the Authority.

Excavation, bracing and sheeting for excavations, dewatering and backfilling shall conform to the requirements of Section 203, Excavation and Embankment, of the Standard Specifications. Trench widths shall be as shown on the Plans. Bedding for the pipes and structures shall be as shown on the Plans and as specified herein.

670.10 Excavation

Excavation for trenches and structures shall be as specified in Section 203, Excavation and Embankment, of the Standard Specifications.

Contractor shall provide adequate bracing and shoring of all excavations in accordance with the requirements of all governing codes and regulations.

All existing piping and structures exposed during excavation shall be adequately supported, braced or otherwise protected during construction activities.

670.11 Backfilling

Backfill and compaction for trenches and structures shall be as specified in Subsection 206.03, Backfilling, of the Standard Specifications.

670.14 Disposal Bed

The disposal bed shall be constructed as detailed on the Plans, as defined by the Rules. If unsuitable material is encountered and removed at or below the disposal bed surface, fill placed to bring the grade up to the disposal bed surface, or fill around the disposal field, clean gravelly course sand shall be placed in accordance with the Subsurface Wastewater Disposal Rules. The LPI shall inspect and approve the prepared disposal field before placement of fill covering the disposal field. Fill shall be placed below and adjacent to the chambers as detailed on the Plans.

670.15 Installation of Pipe

Pipe and fittings shall be installed in conformance with Section 6M of the Rules, as detailed on the drawings and per manufacturer recommendations. Pipe shall be laid on a firm compacted gravel borrow foundation at the line and grade designated. A recess shall be excavated to receive the bell or coupling at each joint if necessary. The piping shall be jointed as specified by the manufacturer to form a watertight joint.

Immediately before laying any pipe, the interior surfaces and ends of sections of pipe shall be cleaned by wiping or other procedure as necessary. All pipe shall be firmly bedded in the underlying soil for its entire length. Joints shall be watertight, adjoining sections of pipe shall form a continuous and smooth invert, spigots shall be fully entered, and the joints shall be slightly flexible. Broken or otherwise damaged pipe shall be replaced at the Contractor’s own expense. Pipes shall be kept free of any deposit or debris. The sewer pipe as laid shall be approved by the MTA before any trench is backfilled or embankment is placed.

Any pipe which is not in true alignment, or which shows any settlement after laying, shall be taken up and re-laid without additional cost to the MTA. Any cribbing or subgrade treatment necessary to prevent settlement shall be placed at the Contractor's own expense.

Any damage to the pipe or invert from any cause shall be promptly repaired by the Contractor at his own expense, before backfilling is commenced or water passes through the pipe.

Wherever water piping must cross sewer piping, a vertical separation of 12 inches shall be maintained. In no case shall a water pipe cross under a sewer pipe.

670.15Testing

Testing/acceptance procedures for the sanitary sewer system shall equal or exceed all state and local requirements.

In case leakage exceeds the above specified amount, the Contractor shall locate the leaks and shall repair them at his own expense. Pipelines with shear-type breaks, fishmouths or damaged gaskets, cracked bells or couplings, hairline fractures, or structural damage of any type shall be replaced in kind. Mechanical sleeve couplings, poured concrete collars or similar repairs are not permitted. The use of pressure grouting repair techniques will not be allowed.

After repairs have been made, the line shall be re-tested and the process of repairing and re-testing shall be repeated until results within the above specified limits are obtained.

670.16Method of Measurement

All the Sewage Disposal System work, including but not necessarily limited to, all labor, components, materials, equipment and incidental work necessary for the satisfactory completion of the system will be measured for payment as a lump sum, complete and accepted.

670.16 Basis of Payment

Payment will be made for the accepted Sewage Disposal System, including all excavation, bedding material, special fill, pipes, fittings, septic tank, backfill, and associated work at the Contract lump sum price, which price shall be full compensation for all labor, materials, equipment and incidental work necessary for the satisfactory completion of the work.

Loam, seed and mulch placed on the completed and accepted disposal system will be paid under their respective pay items.

Payment will be made under:

Pay Item		Pay Unit
670.011	Sewage Disposal System - Southbound	Lump Sum

SPECIAL PROVISION

SECTION 673

STORMWATER FILTER SYSTEM

(Stormwater Soil Filter Bed)

673.01 Description

This work shall consist of constructing a stormwater soil filter bed (Underdrained Soil Filter) to treat stormwater runoff. All work shall be done in accordance with these Specifications and as shown on the Plans, to provide a complete and operating system, and as approved by the Resident.

673.02 Materials

The filter material shall be a thoroughly blended mixture of the following:

a. Sand shall constitute 50-55 percent by volume of the filter material. Sand shall meet Subsection 703.01, Fine Aggregate for Concrete, except no more than five percent % by weight shall pass the # 200 sieve.

b. Sandy loam to fine sandy loam shall constitute 20-30 percent by volume of the filter material. Sandy loam to fine sandy loam shall be a loamy sand with a fines content between 15-25 percent by weight passing the # 200 sieve.

c. Bark Mulch shall constitute 20-30 percent by volume of the filter material. Bark Mulch shall be a moderately fine shredded bark mulch with less than five percent by weight passing the #200 sieve.

d. The Contractor may seek approval from the Resident to use filter material from offsite as provided by a supplier that specializes in providing filter material that complies with the above Specifications and DEP requirements for Stormwater Filters.

e. The combined filter material shall have 8% to 12% by weight passing the #200 sieve, a clay content of less than 2% (determined hydrometer grain size analysis) and 5-10% dry weight of organic matter.

673.021 Testing

Laboratory Testing – A sieve analysis conforming to AASHTO T88 shall be completed on each of the engineered soil mix components, the resulting engineered soil mix, and underdrain bedding material. The material testing laboratory shall test the organic content of the resulting engineered soil mix and its components, the testing shall conform to AASHTO T267. The resulting engineered soil mix shall have 8% to 12% by weight passing the #200 sieve, a clay content of less than 2% and have 5-10% dry weight of organic matter.

Permeability Testing – A permeability test by constant-head method on the engineered soil mix conforming to AASHTO T215. Four tests per USF shall be completed.

673.03 Mixing and Placement

The above materials shall be thoroughly mixed to create a uniform mixture. The stormwater filter material shall be mixed before placement over the top of the underdrain bedding.

The stormwater filter material shall be placed using small equipment (small excavators, small trucks) to distribute the mixed soil material over the top of the underdrain bedding. To preserve filtration characteristics of the material, the stormwater filter material shall not be compacted. Natural compaction over time is preferred over intentional compaction methods. Light compaction due to operation of small equipment operating over the surface of the media to spread the material is acceptable. Such equipment operations shall be minimized to limit compaction. The stormwater filter material shall be graded and leveled to the elevations shown on the Plans and, if required, additional filter material shall be added to fill any depressions or natural settlements that occur prior to acceptance of the work.

673.04 Method of Measurement

The Stormwater soil filter bed will be measured by the number of cubic yards computed using the dimension shown on the Plans for the soil filter bed.

673.054 Basis of Payment

The accepted quantity of stormwater soil filter bed will be paid for at the Contract unit price per cubic yard. Payment shall be full compensation for obtaining the filter bed material, excavating, loading, hauling, mixing, placing, grading, and compacting, and all other materials, tools and labor incidental to the work.

The excavation for the filter bed shall be included for payment under Item 203.20, Common Excavation.

The underdrain for the filter bed and bedding material shall be included for payment under Item 605.016, 6 Inch PVC Underdrain, and Item 605.018, 8 Inch PVC Underdrain.

The drainage geotextile for the filter bed shall be included for payment under Item 620.56, Drainage Geotextile.

The Concrete Barrier Type I – Stormwater Filter but shall be included for payment under Item 526.307, Concrete Barrier Type I – Stormwater Filter.

Payment will be made under:

Pay Item		Pay Unit
673.01	Stormwater Soil Filter Bed	Cubic Yard

SPECIAL PROVISION

SECTION 674

PREFABRICATED CONCRETE MODULAR GRAVITY WALL

(Prefabricated Concrete Modular Gravity Wall – Goosefare Brook)

674.01 Description

The following sentence is added:

This work shall also include the construction of a cast-in-place culvert headwall as shown on the Contract Plans. The cast-in-place headwall shall meet the requirements of Supplemental Specification 502.

674.02 Materials

The seventh paragraph is deleted in its entirely and replaced with the following:

Concrete Leveling Pad. Cast-in-place concrete shall be Class B conforming to Supplemental Specification 502. The horizontal tolerance on the surface of the pad shall be 0.25 in. in 10 ft. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident

674.06 Method of Measurement

This Section is deleted and replaced with the following:

Prefabricated Concrete Modular Gravity Wall will be measured for payment by the lump sum satisfactorily completed and in place as shown on the Contact Plans.

674.07 Basis of Payment

This Section is deleted and replaced with the following:

The accepted quantity of Prefabricated Concrete Modular Gravity Retaining Wall will be paid for at the contract unit price per lump sum complete and in place. Payment shall be full compensation for furnishing all labor, equipment and materials including excavation, foundation material, backfill material, crushed stone, pre-cast concrete units, hardware, joint fillers, woven drainage geotextile, and technical field representative. Cost of cast-in-place leveling pad and culvert pipe headwall and its associated epoxy coated reinforcing will not be paid for separately but will be considered incidental to the Prefabricated Concrete Modular Gravity Wall.

Payment will be made under:

Pay Item		Pay Unit
674.10	Prefabricated Concrete Modular Gravity Wall – Goosefare Brook	Lump Sum

SPECIAL PROVISION

SECTION 719

SIGNING MATERIAL

Section 719.01 Reflective Sheeting

This Subsection is deleted in its entirety and replaced with the following:

Retroreflective sheeting for signs shall meet at a minimum the requirements for ASTM 4956 – Type XI (Prismatic) manufactured by 3M Company, for all signs.

Reflective sheeting, used in sign construction, shall have been manufactured within the six months immediately prior to the fabrication of each sign. Upon delivery at the job site of each shipment of signs, a letter of certification shall be provided that the reflective sheeting conforms to the requirements.

For Type 1 Guide Signs, all reflective sheeting shall be color matched on each sign unit.

All warning signs shall be fluorescent yellow except for Ramp Advisory Speed signs which shall be yellow.

All Construction Series signs that use orange backgrounds shall be fluorescent orange.

All Pedestrian Signs shall be fluorescent yellow-green.

EZ-PASS Purple shall conform to the FHWA Purple color box.

719.02 Demountable High Intensity Reflectorized Letters, Numerals, Symbols, and Borders

This Subsection, including the title, is deleted in its entirety and replaced with the following:

719.02 Letters, Numerals, Symbols, and Borders

All signs shall be manufactured utilizing Direct Applied letters, numerals, symbols and borders or be Digitally Printed meeting all sign sheeting manufacturer's (3M) requirements to ensure that the manufacturer's warranty will be in full effect.

All Type 1 overhead signs, Type 1 interchange signs and any other Type 1 signs over 100 square feet shall utilize Direct Applied letters, numerals, symbols and borders.

Direct Applied

Direct reflectorized applied letters, numerals, symbols and borders shall consist of cut out sheeting that shall meet at a minimum the requirements for ASTM 4956 – Type XI (Prismatic) sheeting. The sheeting material used for the direct applied legend shall be the same type as used for the background.

Digitally Printed

Digital printing methods may be used to produce the sign copy and borders on retroreflective sheeting. Retroreflective sheeting complying with ASTM D 4956 Type XI and designated by the manufacturer as suitable for digital printing traffic signs along with associated ink and premium overlay film. Digitally Printed signs shall meet all sign sheeting manufacturer's (3M) requirements to ensure that the manufacturer's warranty will be in full effect

Transparent and opaque durable inks used in digital printed sign copy and borders shall be as recommended by the sheeting manufacturer (3M). Digital printed traffic colors shall be properly applied and shall have a warranty life of the base retroreflective sign sheeting. Digitally printed signs shall present a flat surface, free from foreign material, and all copy and borders shall be clear and sharp. Digital printed signs shall conform to 70% of the retroreflective minimum values established for its type and color (applicable to traffic colors only), as required by ASTM D 4956. Digital printed signs shall meet the daytime color and luminance, and nighttime color requirements of ASTM D 4956. Printed traffic colors shall meet the accelerated weathering and colorfastness requirements of ASTM D 4956. Digitally printed black shall remain sufficiently opaque for its intended use for the warranty period of the base sheeting. No variations in color or overlapping of colors will be permitted.

Digitally printed traffic signs shall have an integrated engineered match component clear UV- premium protective overlay recommended by the sheeting manufacturer applied to the entire face of the sign.

All digitally printed traffic signs shall utilize an integrated engineered match component system for materials and printing process and equipment. The integrated engineered match component system shall consist of retroreflective sheeting, durable ink(s), and clear protective overlay film, as specified by the sheeting manufacturer, applied to aluminum substrate.

The sign fabricator shall use an integrated engineered match component system digital printer approved by the sheeting manufacturer. Each approved digital printer shall only use the compatible retroreflective sign sheeting manufacturer's engineered match component system products. The sign fabricator shall maintain their digital printer's color calibration according to the sheeting manufacturer's requirements to help ensure digitally printed signs meet the manufacturer's specifications. The fabricator shall be trained by the sheeting manufacturer to produce digitally printed traffic signs that qualify for the sheeting manufacturer's warranty.

General

Type 1 Guide Signs shall have two-inch-tall, series C text that indicates the sign size, and the sign install date (MM/YY) located two inches above the bottom border of the sign.

SPECIAL PROVISIONS

SECTION 800

BUILDINGS AND STRUCTURES

(Toll Administration Building)
(Utility Building)

800.01 Description

Division 800 specifies materials, procedures and requirements for the construction of the Toll Administration Building, complete with all appurtenances, including any and all associated utilities and services within the limits as shown on the Drawings.

The Contractor shall submit to the Resident for approval a cost breakdown of the major components of work for the Toll Administration Building prior to work activities commencing on the building. This breakdown will be used as a basis for monthly pay estimates.

The Contractor shall ensure and be responsible for the total and complete coordination of all work in the Administrative building. A building walk-thru shall occur 30 days prior to anticipated completion of the building. Contractor shall allow the MTA access to the new building to furnish and install necessary equipment for toll operations. This shall be one week prior to the completion of the building.

The Contractor shall ensure and be responsible for the total and complete coordination of all work in the Administrative Building. The Contractor shall generate coordination drawings for the Mechanical Room of the Southbound Administration Building. Coordination drawings shall:

1. Be computer generated.
2. Show a dimensionally accurate representation of all equipment that was approved by the shop drawing process.
3. Show architectural features, structural features, piping, conduit, ductwork, and any other items that require coordination which shall be accurately sized.
4. Be submitted to and approved by the MTA prior to the purchasing of any approved equipment.

This work shall consist of a reinforced slab-on-grade concrete foundation, furnishing and installing a precast concrete structure (Utility Building) in accordance with these Specifications, Plans, or as otherwise directed. The new utility building shall include furnishing and delivery a precast structure and miscellaneous hardware in accordance with the Plans, and this Specification. The construction of the utility building shall be in accordance with the design and dimensions shown on the Plans. This work shall include the painting of the building and the furnishing of all incidentals necessary to produce a completed utility building.

800.02 Building Warranty

The administration building official acceptance date shall be considered the date that the Authority occupies the building for operations associated with live fare collection as described in subsection 107.4.6 at the completion of work. This date shall define the start of the buildings warranty period and all utility services shall become the responsibility of the Authority.

800.03 Work Included

Toll Administration Building construction includes, but is not necessarily limited to, the following:

- Excavating, filling and backfilling for building utilities, services and foundations.
- Construction of reinforced concrete grade beams, pile caps, structural slabs, footings, foundation walls and slabs-on-grade.
- Construction of the Toll Administration Building proper, including all equipment and interior and exterior finishes.
- Furnishing and installing plumbing, heating, ventilating, air conditioning, electrical, data, and telephone, complete with all appurtenances and accessories.
- Furnishing and installing power wires (hot, neutral and ground) from panel DP-1 in the new Toll Administration Building(s) to the lane 1 Booth of the new entry toll plaza(s), complete with all appurtenances and accessories. Note: the conduits outside of the building pay limits are paid for separately.
- Furnishing and installing foundation perimeter 4” diameter underdrain piping, including perimeter 4” diameter underdrain outlet piping. Note: the reducer and roadway drainage will be paid for separately.
- Furnishing and installing flagpole lighting including wiring and conduit.

800.031 Utility Building – Design Requirements

The Contractor shall design the precast concrete utility building in accordance with design specifications as designated on the Plans. The Contractor shall submit design calculations and shop drawings for the precast utility building to MTA for review. A Professional Engineer, licensed in accordance with State of Maine laws, shall sign and seal all design calculations and drawings.

800.032 Utility Building - Materials

All materials covered by other referenced Specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable Specification, all applicable material certification shall be submitted to the Resident Engineer for review.

The utility building shall be a new concrete precast building as manufactured by a designated precast supplier. The 10'-4" Wide x 13'-4" Long x 9'-0" High inside diameter (I.D.) building shall be designed to meet all applicable building standards. The utility building will be

installed according to the Plans and manufacturer's recommendations.

The building shall be equipped with the following: One (1) 3'-0" wide x 7'-0" high exterior single door with BEST lock set and automatic door closure, interior insulation minimum R-14, interior plywood sheathing, and interior and exterior paint. The building shall also be equipped with an exterior mounted commercial grade LED full cut off, 180 degree two head motion activated photocell controlled LED luminaire centered above door.

The new foundation for the new Utility Building as indicated on the Plans. The utility building shall be connected to the reinforced concrete slab-on-grade.

The utility building work shall include furnishing and installing heating, ventilating, air conditioning, electrical, and data with all appurtenances and accessories.

Except as specified otherwise hereinafter, all work shall be done in accordance with the latest edition of the referenced Advisory Circulars and Orders.

Utility building foundation

Concrete shall be Class "A" concrete (4000 PSI) and shall meet the requirements of Section 502.

Reinforcing steel shall meet the requirements of Section 503.

Utility Building Concrete

Precast concrete shall be 4,000 psi and in accordance with ACI 301, 305, 306, 315, 318.

Utility Building Reinforced Steel

Reinforced steel bars shall be intermediate or structural grade deformed bars -type bars and shall meet the requirements of ASTM A 615.

Paint

a. White paint for the body and finish coats on metal and wood surfaces shall be ready- mixed paint conforming to Federal Specification IT-P-1 02.
b. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified white paint by adding ½ pint (0.06 liter) of raw linseed oil to each gallon (liter).
c. Paint for the floor, ceiling, and inside walls shall be in accordance with Federal Specification IT-E-487. Walls and ceiling shall be light gray and the floor shall be medium gray.
d. The roof coating shall be hot asphalt material in accordance with Federal Specification SS-A¬694

Backboard

Provide backboard for mounting all equipment for all electrical cabling. Backboards shall be a minimum of ¾ inch exterior grade plywood, firmly anchored to walls and with a paint finish in accordance with industry standards or directed by the Engineer. Backboards are required on all interior walls of the new building.

800.032 Utility Building Construction

The Contractor shall furnish and deliver the utility building as specified herein and shown on the Plans.

All work shall be performed in accordance with the Plans, these Specifications and State and Local building codes.

If any departures from the Plans are deemed necessary by the Contractor, details of such departures and the reasons shall be submitted in writing to the Engineer for approval as soon as practicable and within 15 days after award of the Contract. No such departures shall be made without the prior written approval of the Engineer.

Building

The Contractor shall manufacture and deliver a new precast building to the location shown on the Plans. The building shall be delivered in one piece. Once the new foundation is completed, the utility building shall be installed on the new foundation. The utility building shall be connected to the new foundation. Before installing the new building, the Contractor shall ensure that all equipment and components are secure within the building so as not to damage equipment and components during installation and that all penetrations are fabricated properly and in the correct location.

Roof

The roof shall be reinforced concrete as shown in the Plans. Reinforcing steel shall be secured in position to prevent displacement during the placing of the concrete. The concrete shall be placed monolithically and shall be free of honeycombs and voids. The surface shall have a steel-trowel finish and shall be sloped as show on the Plans. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

Floor

The floor shall be reinforced concrete as shown on the Plans. The floor surfaces shall have a steel-trowel finish and sealed (see painting). The floor shall be level and without floor drains. A ¼ inch (6 mm) asphalt felt expansion joint shall be placed between floor and foundation. The floor shall be poured monolithically and shall be free of honeycombs and voids.

Conduit in Floor and Foundation

Conduits shall be installed in the foundation in accordance with the details shown on the Plans. The Contractor shall ensure the block outs in the floor slab for the entering/exiting conduits will align with the installed conduits.

Door

The Door shall be 3'-0" wide x 7’-0" high exterior single door with lock set that will accept a BEST key core. The door shall be a metal-clad fireproof class A security door conforming to requirements of NFPA 80. An automatic door closure shall be installed.

Painting

The floor, ceiling, and interior walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two (2) coats of paint as specified below. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving two (2) pounds (0.9 kg) of magnesium fluosilicate or zinc sulphate crystals in one (1) gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Engineer. The floor paint shall be a medium gray color approved by the Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.166 liters) of spar varnish and 1/3-quart (0.083 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one (1) body and one (1) finish coat of white paint.

800.04 Method of Measurement

The Toll Administration Building will be measured for payment by the lump sum, for each building complete and accepted.

The horizontal pay limit shall be 5’-0” from the outside of the Toll Administration Building. The vertical pay limit for this work shall be above the bottom of footing level or bottom of footing subbase, if required.

All work within this pay limit, including utilities, excavation, backfilling, reinforced concrete foundations, slabs on grade, etc., will be included in this pay item. All gas piping from the Toll Administration buildings is paid for under items 633.031 Natural Gas Service – Northbound and 633.032 Propane Service – Southbound. The generator automatic transfer switch is paid for under related Contract items. The Work outside of the horizontal pay limit shall be performed under other portions of the Contract documents with the exception of:

- All work associated with the 4” foundation perimeter underdrain piping including the perimeter underdrain outlet piping beyond the 5’-0” horizontal pay limit.
- All work associated with the installation of the flagpole lighting.

The work described above which shall be included in the Toll Administration Building pay item.

The new Utility Building will be measured for payment by the lump sum, including the reinforced concrete slab-on- grade foundation, all work associated with the 4" foundation underdrain, furnishing and delivering the new pre-cast building as required on the Plans and in this Specification, miscellaneous hardware and fittings, site coordination, all completed, tested, accepted, and ready for operation.

800.05 Basis of Payment

Toll Administration Building construction will be paid for at the lump sum price bid which shall be full compensation for the cost of furnishing all materials, equipment, supplies, tools, incidentals, labor and supervision necessary to satisfactorily complete the work in all respects, to the satisfaction of the Resident. All utility costs to operate the building during construction, testing, commissioning, and general operation will be considered incidental and the Contractor's responsibility until the Authority occupies the buildings for live fare collections, as described in subsection 107.4.6 Prosecution of Work.

Utility Building, including the reinforced concrete slab-on-grade foundation, will be paid for at the Lump Sum Contract unit price for the new Utility Building measured as specified above, which shall be full compensation for the cost of furnishing all materials, equipment, professional services, supplies, tools, incidentals, expenses, labor and supervision necessary for designing, manufacturing, furnishing and installing the precast Utility Building.

Mobilization shall not be within the lump sum pay limit but will be paid for and meet the specifications of pay item 659.10.

Payment will be made under:

Pay Item		Pay Unit
800.01	Toll Administration Building – Northbound	Lump Sum
800.011	Utility Building – Northbound	Lump Sum
800.02	Toll Administration Building – Southbound	Lump Sum

SPECIAL PROVISIONS

SECTION 800

BUILDING AND STRUCTURES

(New Toll Booth Installation)

800.1 Description

Division 800 specifies materials, procedures, and requirements for the construction of the Toll Facilities, comprised of: installation of four toll booths and all associated utilities and services within the limits shown on the Drawings. The work shall be phased as noted on the Plans and outlined in the Specification.

Toll Booth installation includes, but is not limited to the following:

1. Pick up, transport and installation of four (4) toll booths complete with aluminum subframes, floors, doors, windows, counters, etc. Caulking and sealing of booths to concrete and weather-stripping is part of the installation.
2. Cutting, patching, and sealing as required to complete the work per Plans and Specifications.
3. The toll booth shall be supported by galvanized steel support angles 5" x 3-1/2" x 3/8" (8 ea. @ 12' and 8 ea. @ 4'-8"). The angles shall be installed using 1/2" x 5-1/2" stainless steel wedge anchors (56 each). The Contractor shall provide and install galvanized steel support angles with stainless steel hardware.
4. The top face of the galvanized steel angles that the aluminum booth framing will be bearing on need to be covered with ice/water shield or asphaltic paint to create a barrier between the dissimilar metals.
5. Provide and Install aluminum angle trim: The dimensions of the interior faces of the booth barrier walls are a total of 1" greater than the dimensions of the prefabricated toll booths leaving approximately a 1/2" gap along the sides of the barrier. Install backer rod and Sikasil 728 NS between the booth and top of barrier. Install 1-1/2" x 1-1/2" x 1/4" aluminum angle over the caulked gap; apply a bead of silicone caulking prior to installing the aluminum angle. The provided lengths of aluminum angleare longer than the cut lengths to allow for mitered corners. The 1-1/2" aluminum angle shall be attached using self-drilling hex head stainless steel screws.
6. Provide and Install 6" wide EternaBond EPDM tape to the heat pump roof cassette penetration / unit heater vent bump outs and the aluminum roof skin - an approved equal will be considered for the 6” wide EternaBond EDPM tape.
7. The steel support angle under the toll booth electrical chase will need to be notched for electrical conduit.
8. Furnishing and installing plumbing, heating, ventilating, communications and electrical work in the toll booths and canopy as detailed on the Plans.
9. Electrical work in the toll booths includes but is not limited to furnishing and installing a 3 Phase 100 AMP sub-panel fed from the building DP-1 panel and circuit breakers as shown on the electrical panel schedules in the plans. Installation of conduit, wire, supports, brackets, junction boxes, lighting, receptacles, safety switches, plug strips, Cable TV RG-6

cable, and 3CAT 5e cables for radio, phone, and panic button.

10. Associated HVAC system and components, including but not limited to, split ductless heat pumps, heaters, piping, framing, bracing, and thermostats.

11. Contractor shall be responsible for providing and installing the booth unit heater exhaust aluminum enclosure (similar to HVAC cassette unit) to enclose the unit heater exhaust/combustion air intake.

12. Furnishing all needed LP gas (Southbound) or Natural Gas (Northbound) line from junction box located in concrete booth bumper, valves, and secondary regulator for the LP Gas (Southbound) or Natural Gas (Northbound) Cabinet Unit Heater as noted on the Plans and outlined in this Specification. All gas piping from the service connection at the Northbound Toll Administration building and the propane tanks at the Southbound Toll Administration building to the junction box located in toll lane concrete booth bumpers and from the service connection and propane tanks to the generators is paid for under items 633.031 Natural Gas Service – Northbound and 633.032 Propane Service – Southbound.

    The following requirements are included in the LP Gas (Southbound) or Natural Gas (Northbound) Cabinet Unit Heater:

    - Install 1/2" (Size 18 EHD) Corrugated Stainless Steel Tubing (CSST) from the secondary regulator located in the front booth bumper junction box to each Cabinet Unit Heater (CUH-1) located in the Toll Booths. The 1/2” tubing shall be installed in 2” Schedule 80 PVC conduit as shown on the General Plan Sheet.
    - Install a secondary regulator for the cabinet unit heater in the 16” x 16” x 8” PVC junction box in the front booth concrete bumper.
    - At the Cabinet Unit Heaters provide a UL Listed Gas Cock Shut Off Valve and a drip leg.
    - Material to be manufactured by Gastite® (or approved equal) corrugated stainless steel tubing complying with ANSI LC 1 "Fuel Gas Piping Systems Using CSST" and listed with CSA®, ICC and IAPMO. Manufacturing materials to be: ASTM A240 type 300 corrugated stainless steel tubing with a minimum wall thickness of .010", jacketing of UV resistant polyethylene meeting the requirements of ASTM E84 for flame spread and smoke density. All mechanical tube fittings are SAE CA360 brass incorporating double wall flare sealing and Jacket-LockTM jacket capturing for steel tubing protection.

All material associated with Toll Booths installation is included in this item and is shown on the Plan drawings and described in this Special Provision. Electrical and communication items associated with the toll system will be incidental to the toll booth installation item. Furnishing and installing plumbing, heating, ventilating, and electrical items in the toll booths will be incidental to the toll booth installation. Any subsidiary structural and/or architectural work required to complete the electrical, mechanical, HVAC, or plumbing work as shown or noted on the respective drawings shall be incidental to this pay item.

Installation includes setting provided aluminum thresholds in non-shrink grout and sealing perimeter of threshold to concrete island with Sikasil–728 NS or approved equal.

The new toll booth roofs are not capable of supporting any structural loads and contractor is responsible for providing any necessary staging or temporary supports for accessing the toll booth roofs.

800.2 Method of Measurement

The Toll Booth installation will be measured for payment by the lump sum, complete, in-place for the Toll Booth installations.

The MTA will supply the toll booths for installation. The contractor shall transport toll booths from the Authority's Sign Shop Facility at Mile 58.3 northbound. The installation will include all electrical, mechanical and toll systems required as described in the Plans and within this specification, and all labor, material and equipment needed to provide a fully functioning toll booth will be incidental to this item.

800.3 Basis of Payment

Toll Booths will be paid for at the lump sum price bid which shall be full compensation for the cost of furnishing all materials, equipment, supplies, tools, incidentals, and labor and supervision necessary to satisfactorily complete all work prescribed in Division 800 of these Special Provisions. All electrical and HVAC work for the booths required as noted in the Plans including all labor and materials required will be incidental to this item.

Payment will be made under:

Pay Item		Pay Unit
800.401	New Toll Booth Installation – Southbound	Lump Sum
800.402	New Toll Booth Installation – Northbound	Lump Sum

SPECIAL PROVISIONS

SECTION 800

BUILDING AND STRUCTURES

(Generator Pad)

800.1 Description

The work shall consist of installing a concrete pad for the backup generator as detailed in the project plans and these specifications.

800.2 Materials

Concrete shall be Class "A" concrete (4000 PSI) and shall meet the requirements of Section 502.

Reinforcing steel shall meet the requirements of Section 503.

800.3 Method of Measurement

The Generator Pad will be measured for payment by the lump sum, complete, in-place for the Generator Pad installation.

800.4 Basis of Payment

Generator Pad will be paid for at the lump sum price bid which shall be full compensation for the cost of furnishing all materials, equipment, reinforcing steel, ground rods, grounding conductors, terminations, supplies, tools, incidentals, and labor and supervision necessary to satisfactorily complete all work.

Payment will be made under:

Pay Item		Pay Unit
800.901	Generator Pad - Southbound	Lump Sum
800.902	Generator Pad - Northbound	Lump Sum

SPECIAL PROVISIONS

SECTION 800

BUILDING AND STRUCTURES

(Transformer Pad)

800.1 Description

The work shall consist of installing a precast concrete pad for the 3-phase Transformer as detailed in the project plans and these specifications and meeting the requirements of Central Maine Power.

800.2 Materials

Concrete shall be Class "A" concrete (4000 PSI) and shall meet the requirements of Section 502.

Reinforcing steel shall meet the requirements of Section 503.

800.3 Method of Measurement

The Transformer Pad will be measured for payment by the lump sum, complete, in-place for the Transformer Pad installation.

800.4 Basis of Payment

Transformer Pad will be paid for at the lump sum price bid which shall be full compensation for the cost of furnishing all materials, equipment, ground rods, grounding conductors, terminations, supplies, tools, incidentals, and labor and supervision necessary to satisfactorily complete all work.

Payment will be made under:

Pay Item		Pay Unit
800.91	Transformer Pad	Lump Sum

SPECIAL PROVISION

SECTION 800

ELECTRICAL WORK

(Stand-By Generator and Transfer Switch)

800.01 Description

Provide and install a new 3-phase, stand-by generator with a new, 3-phase automatic transfer switch.

The engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 deg to plus 40 deg C .
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 500 feet (150 m).

The Contractor shall provide base warranty coverage on the material and workmanship of the generator set from the Manufacturer for a minimum of twenty-four (24) months from Substantial Completion.

The basis for this specification is Kohler KG100, 60Hz, North Bound Engine Fuel: Natural gas, South Bound Engine Fuel: Propane. Approved equals may be considered from the following manufacturers:

- Onan
- Caterpillar/Olympian
- Cummins Power Generation

Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments. Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

A skid-mounted outdoor sound attenuated enclosure (need level) shall be provided with the manufacturers' standard finish over corrosion-resistant pretreatment and compatible primer. A 12 inch extension base shall be provided.

The electrical output power rating for Standby operation shall support a service load: 105kW/131kVA (minimum), at 80 percent lagging power factor, 208Y/120V, Three phase, 4 - wire, wye, 60 hertz. The Governor shall be adjustable isochronous, with speed sensing. The alternator shall be capable of accepting maximum 311.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.

The Governor shall be adjustable isochronous, with speed sensing. The governing

system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

The Steady-State Voltage Operational Bandwidth shall be 1.0 percent of rated output voltage from no load to full load. The Transient Voltage Performance shall be not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.

The Steady-State Frequency Operational Bandwidth shall be 0.5 percent of rated frequency from no load to full load. The Steady-State Frequency Stability shall be when system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

The Transient Frequency Performance shall be not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.

At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds and then clear the fault automatically, without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non- faulted phases.

Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.

Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

The South Bound Engine Fuel shall be Liquefied Petroleum Gas (Propane).
The North Bound Engine Fuel shall be Natural gas,

The Rated Engine Speed shall be 1800RPM.

The Lube oil pump shall be positive displacement, mechanical, full pressure pump. A Filter and Strainer shall be rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow. Thermostatic Control Valve shall control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe. A Crankcase

Drain shall be arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

Provide a Coolant Jacket Heater, electric-immersion type, factory installed in the coolant jacket system. Comply with UL499 and NFPA 110 requirements for Level 1 equipment for heater capacity and performance. The jacket heater shall be designed for operation on a single 120 VAC, Single phase, 60Hz power connection, and shall be installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss. Provided with a 12VDC thermostat, installed at the engine thermostat housing.

The Cooling System shall be closed loop, liquid cooled, charge air cooler, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C. Coolant shall be a solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer. The size of radiator overflow tank shall be adequate to contain expansion of total system coolant from cold start to 110 percent load condition. The Expansion Tank shall be constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock. A self- contained, thermostatic-control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer. Provide a flexible coolant house with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant material with 50-psig (345-kPa) maximum working pressure with coolant at 215 deg F (102 deg C), and noncollapsible under vacuum.

A Critical type Muffler/Silencer shall be provided with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. Minimum sound attenuation of 25 dB at 500 Hz. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.

The Air-Intake Filter shall be engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" restriction indicator.

The Starting System shall be 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground. The system shall be sized so the components will not be damaged during a full engine-cranking cycle with ambient temperature at maximum. The Cranking Cycle shall be as required by NFPA 110 for level 1 systems. Battery shall be lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.

The Battery Cable shall be sized as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.

Battery Heater: Thermostatically controlled heater will be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten

batteries in place. Provide ventilation to exhaust battery gases.

Battery Stand: Unit mounted with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.

The Battery-Charging Alternator shall be factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.

The Battery Chargers shall comply with UL 1236. Provide a fully regulated, constant voltage, current limited, battery charger in a NEMA, Type 1, wall-mounted cabinet. The Battery Charger shall have an equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

The Battery Chargers shall adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 85 deg C to prevent overcharging at high temperatures and undercharging at low temperatures with full charger output available up to 50 deg C. It shall maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

The Battery Charger shall sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. It shall also sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel. Provide LED indication of general charger condition, including charging, faults, and modes. Provide an LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.

Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection, and control functions for the unit. In the Automatic Mode of operation, when mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

In the Manual Mode of Operation, switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local

(generator set- mounted) and/or remote emergency-stop switch also shuts down generator set.

Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

Provide Indicating and Protective Devices and Controls as required by NFPA 110 for Level 1 system including:

1. Engine lubricating-oil pressure gage.
2. Engine-coolant temperature gage.
3. DC voltmeter (alternator battery charging).
4. Running-time meter.
5. AC voltmeter (3-phase, line to line and line to neutral values).
6. AC ammeter (3-phases).
7. AC frequency meter.
8. AC kVA output (total and for each phase). Display shall indicate power flow direction.
9. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
10. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
11. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
12. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
13. AC Protective Equipment: The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
14. Status LED indicating lamps to indicate remote start signal present at the control, existing alarm condition, not in auto, and generator set running.
15. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
16. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
17. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

The Remote Alarm Annunciator shall comply with NFPA 110. The remote annunciator panel shall be equipped for remote monitoring over ethernet. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition, with An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

Overcrank alarm.
Coolant low-temperature alarm.
High engine temperature prealarm.
High engine temperature alarm.
Low lube oil pressure alarm.
Overspeed alarm.
Low fuel main tank alarm.
Low coolant level alarm.
Low cranking voltage alarm.
Contacts for local and remote common alarm.
Audible-alarm silencing switch.
Air shutdown damper when used.
Run-Off-Auto switch.
Control switch not in automatic position alarm.
Fuel tank derangement alarm.
Fuel tank high-level shutdown of fuel supply alarm.
Lamp test.
Low cranking voltage alarm.
Generator overcurrent protective device not closed.

The generator, exciter and voltage regulator shall comply with NEMA MG 1. The generator shaft shall be directly connected to engine shaft. The exciter shall be rotated integrally with generator rotor. Electrical Insulation shall be Class H. The Temperature Rise shall be rated for 105degree (C) environment. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

The Voltage Regulator shall be SCR type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted. Provide two-thirds pitch stator winding and fully linked amortisseur winding. Subtransient Reactance shall be 15 percent maximum, based on the rating of the engine generator set.

Provide elastomeric isolator pads integral to the generator unless the engine manufacturer requires use of spring isolation.

Components shall be powder-coated and baked over corrosion-resistant pretreatment and compatible primer in the Manufacturer's standard color.

The generator shall be supplied with a Molded-case, electronic-trip type; 100 percent rated; complying with UL 489 and rated for 400-ampere, 3-pole output circuit breaker.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

The Outdoor Generator set enclosure shall be include a vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant and compling with ASCE/SEI 7 for wind loads up to 100 mph. Multiple panels to provide adequate access to components requiring maintenance, minimum two doors per side and keyed alike with recessed locks and rubber sealed to prevent water intrusion. Access to controller and main line circuit breaker shall be in accordance with NFPA 70. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Muffler shall be mounted within enclosure. The enclosure shall provide minimum sound attenuation level: 2 and minimum snow load rating: 70 psf (33.5 kPa).

The Outdoor Generator set enclosure thickness shall be selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

The Outdoor Enclosures and Components shall have a heavy-duty, high-durability, fade-, scratch- and corrosion-resistant finish achieved through a multi-stage finishing process from the genset manufacturer including. Pre-cleaning components and skid cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts then subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive 100 percent epoxy primer electrocoat (e-coat) with high-edge protection. The finish coating shall be Powder-baked painted and have a Corrosion Resistance equal to 3000 hours salt spray test in accordance with ASTM B117.

Provide vibration isolation devices that are freestanding, steel, open-spring isolators with seismic restraint. The housing shall be steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. The outside spring diameter shall not less than 80 percent of compressed height of the spring at rated load and shall support 200 percent of rated load, fully compressed, without deformation or failure. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation and flexible connector materials for steel piping and exhaust shroud and ductwork. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

Factory test the engine-generator set using same engine model, constructed of identical or equivalent components, and equipped with identical or equivalent accessories. Comply with

NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Report factory test results within 10 days of completion of test.

The transfer switch shall be guaranteed against defective material and workmanship in accordance with the manufacturer's published warranty for one year from date of start-up.

The Automatic Transfer Switch shall conform to the requirements of:

1. UL 1008--Standard for Automatic Transfer Switches.
2. NFPA 70--National Electrical Code, including use in emergency and standby systems in accordance with Articles 517, 700.
3. NFPA 110--Standard for Emergency and Standby Power Systems.
4. IEEE Standard 446--Recommended Practice for Emergency and Standby Power Systems (Orange Book).
5. IEEE Standard 241--Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book).
6. NEMA Standard ICS 2-447 Automatic Transfer Switches.

Transfer switches not intended for continuous duty or repetitive load transfer switching are not acceptable. Transfer switches shall be rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric heating, and tungsten-filament lamp load. The Transfer switch shall be rated to withstand the rms symmetrical short circuit current available at the automatic transfer switch terminals, with the type of overcurrent protection specified.

The Transfer switch shall be manufactured by Cummins, Onan, Kohler or ASCO. Transfer switch shall be service entrance rated, 208Y120V, 3-pole solid neutral and fully rated, 400 amperes. The transfer switches shall be furnished in a NEMA 1 enclosure. The withstand and closing ratings with current-limiting circuit breaker protective device shall be 22,000 Amps.

The Transfer switch main contacts shall be of silver composition. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors. The contact transfer time shall not exceed one-sixth of a second. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major

disassembly or disconnection of power conductors. The neutral conductor shall be solidly connected as shown on the plans, a neutral conductor terminal plate with fully rated AL-CU pressure connectors shall be provided. Relay contacts shall be included on the transfer switch and be suitable to drive a 120 volt strobe (MTA provided) to indicate when the generator is running. The Transfer switch shall be provided with an auxiliary relay panel.

The control module shall direct the operation of the transfer switch. The module's sensing and logic circuitry must use a solid-state design for maximum reliability and minimum maintenance. The control module shall have a polarized disconnect plug to enable it to be disconnected from the transfer mechanism for routine maintenance. All printed circuit boards for the control module must be conformal coated on both sides for environmental protection. The control module must be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover.

The control module shall include lamps to indicate normal or emergency source switch position and normal and emergency source availability. These lamps shall be visible when the enclosure door is closed.

The control features shall include an engine-generator exerciser with solid-state, programmable-time switch to start engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Unless directed otherwise by MTA provide factory settings set for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser shall include features include to select if exerciser operates with and without load transfer.

Installation of the generator and transfer switch shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system including grounding the equipment, connection of wiring, and routing and bracing of conductors shall be in accordance with Div 26 specifications. The generator system shall include furnishing and installation of the condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and schedule 40, black steel pipe, the full size of the drain connection, with welded joints; as well as furnishing and installing gas piping, valves. Remote emergency shutoff. The contractor shall examine roughing-in for piping systems and electrical connections and verify actual locations of connections before packaged engine generator installation and shall also perform interconnecting wiring between equipment sections under the supervision of the equipment supplier. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system Proceed with installation only after unsatisfactory conditions have been corrected. Install generators on cast-in-place concrete equipment bases.

The complete generator installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by the Turnpike Authority. Tests shall include:

1. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

2. Installation acceptance tests to be conducted on site shall include the following: verifying phase rotation, phasing, synchronized operation, test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable, Complete battery tests and equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages. Verify specified rates of charge for both equalizing and float-charging conditions. Check for air, exhaust, and fluid leaks, a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test. Complete an exhaust-System Back-Pressure Test using a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine. Complete voltage and frequency Transient Stability Tests use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified. Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.

3. The automatic transfer switch shall be tested to verify compliance with the performance requirements of this specification and tests for generator shall be run concurrently. Inspect physical and mechanical condition. including anchorage, alignment, grounding, and required clearances. Verify that the unit is clean and appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces. Verify tightness of all control connections. Inspect bolted electrical connections for high resistance using one of the following methods, or both: low-resistance ohmmeter or by calibrated torque-wrench method according to manufacturer's published data. Perform transfer operations Verify positive mechanical interlocking between normal and alternate sources. Perform visual and mechanical inspection of surge arresters. Inspect control power transformers for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition. Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

4. Perform insulation-resistance tests on all control wiring, and feeders with respect to ground. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance. Check for electrical continuity of circuits and for short circuits. Verify time-delay settings. Verify pickup and dropout voltages by data readout or inspection of control settings. Perform a power failure test on the generator installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation

of the system for at least 2 hours. Include simulating loss of phase-to-ground voltage for each phase of normal source.

5. Coordinate timing and obtain approval for start of test with site personnel.

The generator equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the Authority.

800.02 Method of Measurement

The Stand-By Generator and Transfer Switch will be measured for payment as one lump sum unit, complete, and accepted.

800.03 Basis of Payment

Payment for installing the generator and transfer switch as described herein will be paid for at the Contract Lump Sum price which shall include provision and installation of the generator, enclosure, battery charger, transfer switch, and all associated hardware and wiring for a complete operational system.

Payment will be made under:

Item	Description	Unit
800.921	Stand-By Generator and Transfer Switch - Southbound	Lump Sum
800.922	Stand-By Generator and Transfer Switch - Northbound	Lump Sum

SPECIAL PROVISION

SECTION 801

SANITARY SEWER

801.01 Description

This work shall consist of constructing gravity sewers.

801.02 Materials

Meet Sections:

Sewer Line Bedding and Initial Backfilling Stone	703.02 for class AA
PVC Pipes & Fittings (4 in)	ASTM D3034 (SDR 35)

801.03 Construction Requirements

Excavation Trenches shall be excavated in accordance with the requirements of Section 206 – Structural Excavation and wide enough to allow joining the pipe and compacting the bedding and backfill material under and around the pipe. Unless otherwise designated, trench walls shall be as nearly vertical as possible and the trench width no greater than necessary for installation of the pipe.

Bedding The inspection standpipe and pipe line shall be bedded in original material.

Laying The Contractor shall not install nor backfill gravity sewers between December 15th and April 1st without written permission. Installing shall begin at the downhill end of the cellar drain line. Bell or groove ends shall be placed facing uphill.

Joining The pipe ends shall be thoroughly cleaned before the joint is made. Joints shall be made in accordance with the manufacturer's recommended procedures.

Backfilling After the inspection standpipe and pipe are installed, it will be inspected before any backfill material is placed. All pipe found to be out of alignment, unduly settled or damaged to the extent that full performance is impaired, shall be taken up and re-laid or replaced. One bag of concrete mix shall be installed around the foot of the standpipe, placement as per manufacturer’s recommendations.

Trenches shall be backfilled in accordance with Section 206.03 and as follows. The backfill shall be original excavation in 12 in maximum lifts and shall be thoroughly compacted with power tampers or vibratory compactors or other approved equipment or combination of equipment.

801.04 Method of Measurement

PVC pipe will be measured by the linear foot along the invert, horizontally and vertically, laid as directed, complete in place, and accepted. Pipe laid in excess of the authorized length will not be included. Pipe installed inside a manhole will not be measured for payment. Fittings and caps will be measured as three linear feet of the pipe item used.

801.05 Basis of Payment

The accepted quantities of pipe will be paid for at the contract unit price per linear foot, for the types and sizes specified, complete in place and shall be full compensation for all labor, materials, equipment, excavation, dewatering, bedding, furnishing and installing pipe, removal and disposal of existing pipes, connecting to manholes, connecting to existing cellar drain, concrete footing, backfill, compacting, cleaning, testing, maintaining existing flows, and all other incidental required.

No payment will be made for pipe ordered without written approval of the Resident when such pipe is not required to be installed for completion of the work.

Payment will be made under:

Pay Item		Pay Unit
801.16	6” PVC Sanitary Sewer (SDR-35)	Linear Foot
801.17	8” PVC Sanitary Sewer (SDR-35)	Linear Foot

SPECIAL PROVISION

SECTION 803

UTILITY TEST PITS

(Test Pits)

Description:

This work shall consist of excavating and back filling test holes to locate existing utilities at locations shown on the plans or as directed by the Resident.

Construction Requirements:

The work shall be done in a manner that provides safe passage of the traveling public at all times. Coordination with the utilities is required prior and during the test pit activities. An authorized representative from the utility shall be present during the test pit activity. Test pits shall be completed in a manner that does not damage any utilities. Any damage to utilities or other roadway features by the test pit operations shall be repaired by the Contractor at no additional cost and shall be to the Resident's satisfaction.

The Contractor shall coordinate with the Department's surveyor on locating the utilities once exposed.

Once the location work is complete, the Contractor shall backfill the hole, place gravel and pavement over the test pits in a manner consistent with the existing conditions and in accordance with the standard specifications for backfilling.

Method of Measurement:

Test Pits will be measured for payment by each.

Basis of Payment:

The accepted quantity of Test Pits will be paid for at the contract unit price per each, which shall be full compensation for all labor, materials, tools, equipment, and incidentals necessary to the complete the work. Associated traffic control will not be paid for separately and is considered incidental to the test pit item.

Payment will be made under:

Pay Item		Pay Unit
803.01	Test Pits	Each

SPECIAL PROVISION

SECTION 803

SANITARY SEWER MANHOLES

803.01 Description

This work shall consist of the construction and placement of sanitary manholes

803.02 Materials

Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Portland Cement	701.01
Clay or Shale Brick	704.01
Concrete Masonry Blocks	704.03
Joint Mortar	705.02
Reinforcing Steel	709.01
Precast Concrete Units	712.06
Tops and Traps	712.07
Corrugated Metal Units	712.08
Catch Basin and Manhole Steps	712.09

Except as otherwise provided on the plans, concrete for these structures shall meet the requirements of Section 502 - Structural Concrete.

Manhole frames and covers shall be circular. Diameter of the covers shall be 24” and frame outside diameter shall be 26”. Sewer covers shall have “Sewer” cast into the cover. Refer to details in the plan set.

803.03 Construction Requirements

Concrete manholes shall be constructed of precast units, except that concrete blocks may be used around inlet and outlet pipes. Joints for precast concrete units shall be of Portland cement mortar, rubber gaskets, flexible plastic rings, mastic joint filler or other approved types to form a watertight joint. Joints for concrete blocks shall be of Portland cement mortar, not more than ½ inch wide, completely filled and neatly tooled on the inside of the structure.

Manholes shall be placed to the required grade on a compacted foundation of uniform density. Inlet and outlet pipe elevations may vary from the elevations shown on the plans depending upon field conditions.

Pipe sections entering manholes shall be firmly connected to the structure wall with no part of the pipe projecting more than 6 inches inside the wall. When a section of culvert is cut, the end shall be finished in a skillful manner.

Metal frames and traps, when called for, shall be set in a bed of clay bricks or shale bricks and mortar, or otherwise secured as shown on the plans. Castings shall be set to the correct elevation before the next final course of paving material has been placed.

Upon completion, each manhole shall be cleaned of all accumulation of silt, debris, or foreign matter and shall be kept clean until final acceptance of the work.

Sanitary sewer shelves, channels and inverts shall be constructed of brick set in mortar or pre-cast concrete. Pre-cast inverts shall be cured at least 7 days in a controlled environment with use of plasticizers to reduce moisture content before applying epoxy. Epoxy shall be Sikagard 62 or approved equivalent and shall be cured in accordance with manufacturer's recommendations before delivery to the project site.

Outside surface of any masonry work shall be plastered with mortar from ¼ to 3/8 inch thick. The masonry shall be properly wetted before the plaster is applied. The plaster shall be carefully spread and troweled so that all cracks are thoroughly worked out. After hardening, the plaster shall be carefully checked by being tapped for bond and soundness.

All brick masonry surfaces with mortar shall be waterproofed with one coat of Dehydratine 6 Trowel Mastc, Dehydratine 10 Semi-mastic or approved equivalent.

All poured concrete or precast concrete surfaces shall be waterproofed with two heavy coats of bituminous waterproofing materials. The material shall be Minwax Fibrous Brush Coat made by the Minwax Company, New York, New York; Tremco 121 Foundation Coating, made by the Tremco Manufacturing Company, Cleveland, Ohio; Inertol No-7 made by Inertol Company, Newark, New Jersey or approved equal.

803.04 Testing

Vacuum Test: Prior to backfilling, all manholes shall be vacuum tested in the following manner:

a. A vacuum of 10 inches of Hg shall be drawn on the manhole and the loss of 1 inch of Hg vacuum timed. The manhole shall be considered to have passed the test if the time for loss of 1 inch of Hg is 2 minutes or longer.
b. If the manhole fails the initial test, the Contractor shall locate the leaks and make repairs. The manhole shall be retested until a satisfactory result is obtained.

803.05 Method of Measurement

Sewer manholes will be measured by the number of units, measured as follows, complete, and accepted in place.

a. Complete Structures. Each sewer manhole having a depth up to 8 feet from the top of the grate or cover to the top of the floor, measured to the nearest foot, will be one unit.

⅛ of a unit will be added for each additional foot over 8 feet measured to the nearest foot. Depth measurements in excess of the dimensions authorized will not be included.

803.06 Basis of Payment

The accepted quantities of sewer manholes will be paid for at the contract unit price each of the respective types complete in place. Frames, grates, covers, steps, internal or external drops or other appurtenances for new sewer manholes shall be considered part of the structure and no separate payment will be made. There will be no payment for cleaning new manholes. Payment will be full compensation for supplying all equipment and labor to clean the basins and manholes and to dispose of the waste.

The cost of maintaining flows in existing sewer lines and manholes and any maintenance and cleaning of said sewers that may be required as a result of new manhole installations shall be incidental to the related pay item and no separate payment for this work will be made.

Connection of existing pipes to proposed structures, including all necessary excavation, fittings and backfill shall be considered incidental to the respective structure and no separate payment shall be made.

Excavation and backfill will be considered incidental, except as provided in Section 206 - Structural Excavation.

Payment will be made under:

Pay Item		Pay Unit
803.173	Sewer Manhole – 4’ Diameter	Each
803.174	Sewer Manhole – 4’ Diameter w/ Drop Inlet	Each

SPECIAL PROVISION

SECTION 832

BOLLARD

(Type A Steel)

832.01 Description

This work shall consist of furnishing and installation of Type A Steel Site Bollards with cast in place concrete base and LDPE bollard sleeves in accordance with these Specifications, and as shown on the Plans or as approved by the Resident.

832.02 Materials

Bollards shall 6" Diameter Schedule 40 steel tube as shown on the plans, Concrete shall be Class "A" cement concrete (4000 PSI). Reinforcing steel shall meet the requirements of Section 503. Bollard Sleeve shall be ¼" thick Low Density Polythene

832.03 General

LDPE sleeve shall be a minimum ¼" thick, premanufactured bollard sleeve, color OSHA Safety Yellow.

832.04 Method of Measurement

Bollards will be measured by each unit complete and in place.

832.05 Basis of Payment

The accepted quantity of bollards will be paid for at the Contract unit price each which payment shall be full compensation for furnishing and installing bollards, bollard sleeves, concrete base and bollard infill, excavation, backfill, compaction, tools, equipment, labor and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item		Pay Unit
832.41	Type A Steel Site Bollard	Each

SPECIAL PROVISION

SECTION 845

SPECIAL WORK

(Relocate Business Sign No. 1)
(Relocate Business Sign No. 2)
(Relocate Business Sign No. 3)

845.01 Description

This work shall consist of removing and resetting Business Signs No. 1, 2 & 3, in accordance with these specifications, as shown on the plans, and as directed by the Resident.

845.02 Schedule of Work

The existing business signs shall be removed from the locations along Route 112 as noted on the plans. The Contractor shall notify the Resident a minimum of 15 days in advance of the planned existing sign removal. The Contractor shall have 15 days to reinstall the existing sign on the new foundations once it has been removed. Contractor shall coordinate with the abutter to determine new location of signs.

845.03 Method of Measurement

Relocation of Business Signs will be measured for payment by Each once the work has been completed.

845.04 Basis of Payment

The accepted Relocation of Business Signs will be paid for at the contract Each price. Payment will be full compensation for the removal and resetting of the business signs and resetting or design of new foundations, relocating the existing electrical and communication feeds, and all labor and incidentals.

Payment will be made under:

Pay Item		Pay Unit
845.301	Relocate Business Sign No. 1	Each
845.302	Relocate Business Sign No. 2	Each
845.303	Relocate Business Sign No. 3	Each

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART III – DIVISION 800

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

DIVISION 800

TABLE OF CONTENTS

The specification sections listed below, and all State of Maine Department of Transportation "Standard Specifications for Highways and Bridges" referenced therein, comprise Division 800:

SECTION 031000
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish, construct, and remove formwork to produce cast-in-place concrete structures as indicated and specified.

B. Use formwork to cast all concrete structures including foundation mats, base slabs, and footings, but excluding fence and signpost footings.

C. Furnish, construct, and remove formwork for all structures as indicated and specified in other Sections.

D. Any form system such as Spanall Shoring system that may cause notches in the formed concrete requiring mortar or grout fill after the form removal shall not be used.

1.02 RELATED WORK

A. Section 032000: Concrete Reinforcing.

B. MTA Specification Section 502: Structural Concrete.

1.03 REFERENCES

A. American Concrete Institute (ACI):

1. ACI Guide to Formwork for Concrete, ACI 347R.

2. ACI-117 standard tolerances for concrete construction and materials.

B. U.S. Product Standard PS 1 for Construction and Industrial Plywood.

C. 310 CMR 7.25U Best Available Controls for Consumer and Commercial Products.

1.04 DEFINITIONS: N/A

1.05 SYSTEM DESCRIPTION: N/A

1.06 SUBMITTALS

A. Submit formwork design, stamped and sealed by a Structural Engineer Registered in the State of Maine.

1.07 QUALITY ASSURANCE

A. Produce working drawing showing details of form type, methods of form construction and erection, location of form joints, form ties, and shoring. Keep a copy of drawings in field office during form erection.

B. Notify the Owner's Representative a minimum of four (4) hours before the closure of forms, which would make subsequent inspection unfeasible.

C. Construct formwork in accordance with ACI-347 and as specified.

D. Comply with the requirements in ACI-117 for tolerances of formed surfaces except as specified in Table 1 at the end of this section.

E. Check vertical and horizontal alignment of formwork by means of transit or theodilite before placing concrete. Permit the Owner's Representative to examine formwork with the set up instrument, if requested. Adjust formwork to maintain the concrete tolerances specified after placing concrete.

F. Do not remove formwork before the minimum time limitations, as specified in Paragraph 3.03, are met.

G. Do not leave wood, metal or plastic formwork in place. Remove all formwork from concrete.

H. Formwork shall be designed by in conformance with the requirements of this section.

1.08 DELIVERY, STORAGE, AND HANDLING: N/A

1.09 PROJECT/SITE CONDITIONS: N/A

1.10 SEQUENCING AND SCHEDULING: N/A

PART 2 - PRODUCTS

2.01 MATERIALS

A. Formwork Design Requirements:

1. Provide and design formwork to support vertical loads and lateral pressure resulting from placement and vibration of concrete in accordance with ACI-347.

2. Provide and design formwork to locate bracing, which will maintain form stability, to comply with the tolerances specified.

3. Provide and design formwork to anticipate deflection and creep due to weight and pressure of fresh concrete and construction loads.

4. Provide temporary openings in wall and column forms, to facilitate cleaning and inspection.

5. Provide and design forms with openings allowing placement of concrete without segregation. Provide drop chutes or drop pipes to prevent accumulation of hardened concrete on forms and reinforcement above fresh concrete and to prevent concrete segregation.

6. Provide and design forms to conform with expansion and construction joint locations indicated, and to match architectural lines.

B. Wood Forms:

1. Provide forms for concrete surfaces, which will not be exposed to view in finished work, of lumber, which will not deflect beyond finish tolerances specified.

2. Provide forms for concrete surfaces which are exposed to view or painted in the finish work with material that is not reactive with concrete and which will produce surfaces equivalent in smoothness and appearance to that produced by new plywood panels conforming to U.S. Product Standard PS 1, Exterior Type Grade B-B. Provide forms, which will not deflect beyond, finish tolerances specified. Provide 4 x 8 foot panels or larger to reduce form seam lines, except where restricted by location of openings, architectural lines, joints, or shape of the structure.

3. Provide bracing secured to forms, which will prevent deflection and maintain the tolerances specified.

C. Steel Forms:

1. Provide forms for concrete, which produce surfaces equivalent in smoothness and appearance to that produced by new plywood panels as specified for wood forms.

2. Provide forms with strength to restrain forms from deflecting beyond finish tolerances specified.

3. Provide forms having sheet steel lining with steel back up framing. Do not use sheet steel lining with wood back up framing.

D. Tubular fiber Forms:

1. Provide forms with spirally constructed laminated plies of fiber.

2. Provide forms with wall thickness as recommended by the manufacturer to meet load requirements of the various uses and sizes.

3. Provide forms with wax coated outside surfaces for moisture resistance.

4. Provide forms with inside surface coated with bond-breaker compound.

E. Form Ties:

1. Provide factory fabricated tie system that will prevent form deflection beyond finished tolerances specified and will not spall concrete upon the ties removal.

2. Provide ties fitted with devices that will form cone shape holes in concrete surface not less than 3/8 inch interior diameter or more than 1-1/4 inch in exterior surface diameter and at least 1-1/2 inches deep such that the portion of the tie remaining in the concrete will be at least 1-1/2 inches back from concrete surfaces.

3. Provide ties, which pass through walls, subjected to hydrostatic pressure, including exterior foundation walls with continuously attached waterstop devices to break surface continuity around ties.

F. Form Releasing Agents:

1. Provide form releasing agents of commercial formulation that will not bond with or stain and reduce the concrete ability to meet the specified requirements.

2. Form releasing agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion.

3. Form releasing agents shall not impede the wetting of surfaces to be cured with water or curing compounds.

4. Volatile organic compound emissions of form releasing agents shall not exceed 2.09 pounds per gallon (250 grams per liter).

G. Chamfer Strips:

1. Provide three quarter inch triangular fillets, milled clear straight-grain pine, surfaced each side, or extruded vinyl type, with or without nail flange to form all exposed concrete edges such as columns, pilasters, beams, curbs, equipment pads, and as indicated.

PART 3 - EXECUTION

3.01 BOND BREAKER COATING

A. Coat forms with bond breaker prior to placement of reinforcing steel or before the forms are placed in its final position. Do not allow bond breaker to come in contact with reinforcement.

B. Do not allow excess bond breaker material to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is to be placed.

C. Bond breaker material to be compatible with subsequent curing compound and/or surface treatment.

3.02 FORM CONSTRUCTION

A. Erect forms in accordance with the Contractor produced working drawings, to support the vertical loads and lateral pressure in accordance with ACI-347, and anticipated concrete placement height.

B. Erect forms butted tightly together to prevent leakage of grout and cement paste.

C. Fit bottom of forms to the preceding lift to form a smooth complete surface, free from irregularities and offsets and to prevent leakage of grout and cement paste.

D. Arrange joints between formwork panels vertically and horizontally to match architectural lines and construction joints.

E. Set forms true to the indicated line and grade, to obtain specified concrete finish tolerances. Correct deviations in line before and after concrete placement, even to the extent of demolishing, removing demolished material from the island and rebuilding concrete structures, at no additional cost to the Authority.

F. Control grade of finished surfaces and horizontal construction joints by setting chamfer strips or grading strips true to grade.

G. Inspect forms and embedded items before placing concrete. Forms and excavation shall be free from water, dirt, debris, and foreign matter when concrete is placed.

H. Clean all form surfaces in contact with concrete. Repair all surfaces to obtain specified concrete finish. Withdraw all projecting nails and fill holes before reusing form material.

I. Protect materials in construction joints.

K. Maintain steel form temperature between 50 and 95 degree F before, during and after concrete placement until the forms are removed.

3.03 REMOVAL OF FORMS

A. Do not remove forms until concrete has aged as follows:

1. Elevated beams and elevated slabs: 7 days minimum.

2. Grade beams, walls and vertical surfaces: 3 days minimum.

3. Bulkhead forms may be removed 48 hours after concrete placement, provided adjacent concrete is placed within 24 hours after bulkhead removal.

B. Before form removal in accordance with Paragraph 3.03.A, elevated beams and elevated slabs shall have attained at least 70 percent of specified 28 day strength as determined by the Contractor's Independent Testing Laboratory in accordance with Section 03300 and also sufficient strength to support safely its own weight and construction live loads and lateral pressures unless otherwise indicated. The strength of concrete required for form removal shall be determined in accordance with ACI 301-96, paragraph 2.3.4.

C. Remove all tubular fiber forms in accordance with requirements for vertical surfaces given in Paragraph 3.03.A.2.

D. Reshore elevated elements when indicated, and when concrete weight plus construction load exceeds the design live load of the supporting framework.

3.04 TOLERANCES

A. Comply with the requirements in ACI 117 for tolerances for formed surfaces except as specified in Table 1.

TABLE 1
TOLERANCES FOR FORMED SURFACES

1.	Vertical alignment (plumb):		
	a. In the lines and surfaces of foundation mats, base slabs, and walls	In any 10 feet of length Maximum for entire length	1/4 inch 1 inch
2.	Variation from the level or from the grades indicated on the drawings	In any 10 feet of length	1/4 inch
3.	Variation of the linear building lines from established position in plan	In any 20 feet Maximum	1 inch 1 inch
4.	Variation of distance between walls	1/4 inch per 10 feet of distance and not more than 1 inch total variation from a straight line, for entire wall length and height	
5.	Variation in the sizes and locations of sleeves, floor openings, and wall openings	Minus Plus	1/4 inch 1/2 inch
6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus Plus	1/4 inch 1/2 inch
7.	Tolerances are not cumulative		

END OF SECTION 031000

SECTION 032000
CONCRETE REINFORCING

PART 1 -GENERAL

1.01 SUMMARY

A. Furnish and place all reinforcement and accessories.

B. Furnish and place all reinforcement as specified and indicated in other Sections.

C. Furnish all CMU wall reinforcement for the masonry as indicated and as specified in Section 042000. Embed dowels into concrete at the top, middle and bottom of the CMU walls as specified or indicated.

1.02 RELATED WORK

A. Section 031000: Concrete Forming and Accessories

B. MTA Specification Section 520: Structural Concrete

C. Section 042000: Unit Masonry, General

1.03 REFERENCES

A. America Society for Testing and Materials (ASTM) Publications:

1. A185: Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. A615: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ACI SP-66, ACI Detailing Manual.

C. ACI 318, Building Code Requirements for Reinforced Concrete, and Commentary.

D. AWS D1.4, American Welding Society, Structural Welding Code, Reinforcing Steel.

1.04 DEFINITIONS: N/A

1.05 SYSTEM DESCRIPTION: N/A

1.06 SUBMITTALS

A. Submit the following:

1. Mill test reports for each shipment of reinforcement. Identify reports with specific lots in shipment and submit prior to use of reinforcement in work.

2. Chemical composition of reinforcement steel. Ladle analysis to state percentage of carbon, phosphorous, manganese and sulfur present in steel.

3. Welder's certification to the Owner's Representative, prior to use of reinforcement in work, in accordance with AWS D1.4 prior to welding, when welding is indicated or specified.

4. Shop and placement drawings to be reviewed by the Owner's Representative prior to fabrication, which show:

a. All construction and expansion joints.

b. Reinforcement detailed in conformance with ACI SP-66.

c. Support bars and details of bar supports including type, size and spacing.

d. Marking for each reinforcement item.

e. Locations of bar cut-offs, splices and bar development.

5. Two samples of mechanical reinforcing bar splices.

1.07 QUALITY ASSURANCE

A. Fabrication: Do not commence fabrication before shop drawings are reviewed by the Owner's Representative. Maintain tolerances within requirements of ACI SP-66.

B. Replace all reinforcement with bends and kinks not shown on fabrication shop drawings. Remove from job site all such reinforcement and replace with new fabricated steel at no additional cost to the Owner. Field bending of reinforcement at the work site is prohibited.

C. Placement: Place reinforcement to tolerances given in ACI 318.

D. Perform welding indicated and specified in conformance with requirements of AWS D1.4 for procedures, and welding.

E. All welding performed by qualified operators, certified by test within the past 12 months, in accordance with requirements of AWS D1.4.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement and accessories to work site with items of same size and shape fastened in bundles clearly marked with wired-on metal identification tags giving size and mark.

B. Store reinforcement and accessories off ground on platform, or skid supports and protect from ground splatter.

C. Protect reinforcement from rusting, deforming, bending, kinking and other injury.

1.09 PROJECT/SITE CONDITIONS: N/A

1.10 SEQUENCING AND SCHEDULING: N/A

PART 2 - PRODUCTS

2.01 STEEL REINFORCING BARS

A. Provide newly rolled deformed billet-steel reinforcement bars conforming to ASTM A615, Grade 60.

B. Provide mill bent reinforcing bars, bent cold to dimensions indicated and conforming to requirements of ACI SP-66, and ASTM A767 Class II with Supplementary Requirements S1, S2 and S3 for galvanized steel.

C. Provide weldable reinforcement conforming to ASTM A706 as indicated or specified.

2.02 TIE WIRE

A. Provide 16-gage minimum, mild steel or annealed iron tie wire.

B. Provide 16-gage minimum, mild steel or annealed iron tie wire, with galvanize coating applied by hot-dip process. Provide tie wire with a chromate treatment coating after galvanizing.

2.03 REINFORCING BAR SUPPORTS

A. Provide number 5 minimum support bars.

B. Provide plastic protected bar supports in contact with exposed surfaces in conformance with ACI SP-66 (Class 1 – Maximum Protection).

C. Provide 3-inch by 3-inch plain precast concrete blocks and precast concrete doweled blocks for bar supports. Provide block thickness size to produce concrete cover of reinforcement as indicated. Provide blocks of Type II cement in accordance with Section 033000.

2.04 WELDED WIRE FABRIC

A. Provide welded wire fabric conforming to ASTM A185.

B. Provide size indicated.

C. Provide flat sheets of welded wire fabric conforming to ASTM 185.

2.05 FABRICATION

A. After shop drawings are reviewed by the Owner's Representative, provide fabricated units of reinforcement conforming to the type, shape and size indicated on the fabrication shop drawings.

B. Provide reinforcing bars cut and bent before shipment to the site. Provide bars bent cold and in a manner that will not injure the material.

PART 3 - EXECUTION

3.01 PLACEMENT

A. Before placing in form, clean all reinforcement and accessories of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings that would destroy or reduce the bond with the concrete.

B. Place reinforcing bars to tolerances given in ACI 318 and hold in position using tie wire with ends pointed away from forms.

C. Set and tie all dowel reinforcement before placing concrete.

D. Bars may be moved to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, resulting arrangement of bars is subject to rejection by the Authority. Place the total number of bars required as specified and indicated.

E. Use chairs, bolsters, and spacers to hold reinforcing bars and welded wire fabric in place, of sufficient strength to resist crushing under load in accordance with ACI SP-66. Metal chairs which extend to the surface of the concrete, stones, brick chips and wood block supports shall not be used.

F. Use precast concrete bar support blocks for foundation mats, base slabs, footings, pile caps, grade beams, and slabs on grade.

G. Placing bars and welded wire fabric on layers of fresh concrete as the work progresses, and adjusting bars and welded wire fabric during the placement of concrete shall not be permitted.

H. Place bar laps in contact and tie securely, or space transversely apart to permit embedment of entire surface of each bar in concrete. Length of laps for bars to conform with requirements of ACI 318, unless otherwise indicated.

I. Do not splice reinforcement steel in mats, slabs, beams, girders and walls at points of maximum stress unless otherwise indicated.

J. Lap splice wire-mesh reinforcement at least two full meshes; stagger splices to avoid continuous laps in either direction and wire securely together.

K. Provide continuous reinforcement through construction joints.

L. Do not use continuous reinforcement or other fixed metal items through expansion joints. Provide two-inch reinforcement clearance from each face of expansion joint.

M. Do not field bend bars, including bars partially embedded in concrete, unless indicated. Do not straighten or bend in manner injurious to steel, or concrete.

N. Do not place bars that have kinks and bends other than shown on reviewed shop drawings. Remove all such damaged bars from job site and replace at no additional cost to the Owner.

O. Do not use heat to bend or straighten reinforcing steel.

P. Welding of reinforcing bars shall be permitted only where indicated. Perform all welding in accordance with AWS D1.4.

Q. All welding of reinforcing steel shall be performed only by operators certified by test in accordance with AWS D1.4.

R. Tack welding to, or of, reinforcement is prohibited.

S. Immediately paint all reinforcement, which is to be exposed for more than 90 days with coat of neat cement grout to prevent rust formation.

T. Furnish and install safety caps on all exposed ends of vertical reinforcement that poses a danger to life safety.

END OF SECTION 032000

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all materials, labor, tools and equipment to complete all cast-in-place concrete including electrical duct banks and structures, formwork, reinforcement and all incidental Work, as indicated and specified.

B. The Work of this Section shall also include the installation of embedded items furnished under the other Specification Sections.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 RELATED WORK

A. Section 031000: Concrete Forming and Accessories

B. Section 032000: Concrete Reinforcing

1.03 REFERENCES

A. ACI Standards. The following standards of the American Concrete Institute (ACI) form a part of these Specifications, and indicate the minimum standards required.

1.	ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy Weight and Mass Concrete
2.	ACI 212.2	Guide for Use of Admixtures in Concrete
3.	ACI 214R	Recommended Practice for Evaluation of Strength Test Results of Concrete
4.	ACI 301	Specifications for Structural Concrete
5.	ACI 302.1R	Guide for Concrete Floor and Slab Construction
6.	ACI 304R	Guide for Measuring Mixing, Transporting and Placing Concrete, including Placing Concrete by Pumping Methods (ACI 304.2R)

7.	ACI 305R	Hot Weather Concreting
8.	ACI 306R	Cold Weather Concreting
9.	ACI 308.1	Standard Specification for Curing Concrete
10.	ACI 309R	Guide for Consolidation of Concrete
11.	ACI 311.4R	Guide for Concrete Inspection
12.	ACI 315	Details and Detailing of Concrete Reinforcing
13.	ACI 318	Building Code Requirements for Structural Concrete and Commentary
14.	ACI 347R	Guide to Formwork for Concrete
15.	ACI 350R	Code Requirements Environmental Engineering Concrete Structures and Commentary

B. ASTM Standards. The following standards of the American Society for Testing and Materials (ASTM) form a part of these Specifications. Unless otherwise specified, materials and methods of test shall conform to ASTM Standards.

1.	A 36	Carbon Structural Steel
2.	A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
3.	A 307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
4.	A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
5.	C 31	Practice for Making and Curing Concrete Test Specimens in the Field
6.	C 33	Concrete Aggregates
7.	C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
8.	C 94	Ready-Mixed Concrete

9.	C 109	Test method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens)
10.	C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
11.	C 131	Test method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
12.	C 138	Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
13.	C 143	Test Method for Slump of Hydraulic Cement Concrete
14.	C 150	Portland Cement
15.	C 171	Sheet Materials for Curing Concrete
16.	C 172	Practice for Sampling Freshly Mixed Concrete
17.	C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
18.	C 192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
19.	C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
20.	C 260	Air-Entraining Admixtures for Concrete
21.	C 309	Liquid Membrane-Forming Compounds for Curing Concrete
22.	C 494	Chemical Admixtures for Concrete
23.	C 881	Epoxy-Resin-Base Bonding Systems for Concrete
24.	D 41	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
25.	D 226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

26.	D 312	Asphalt Used in Roofing
27.	D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
28.	D 2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

C. American National Standards Institute (ANSI)

1.	A 116.1	Two Components Elastomeric Sealing Compounds

D. Federal Specifications

1.	TT-S-227B	Sealing Compound, Rubber Base, Two Component

1.04 DEFINITIONS: N/A

1.05 SYSTEM DESCRIPTION: N/A

1.06 SUBMITTALS

A. Submit samples of materials and certificates of compliance for material and testing as specified in Paragraph 2.02. Samples shall be of such size as required for testing.

B. Submit shop drawings for fabrication, bending details and placement of all reinforcing steel. Comply with ACI 315, showing bar schedules, stirrup spacing, and diagrams of bent bars and arrangement of concrete reinforcement including actual dimensions provided for concrete cover over bars. Include special reinforcement required at openings through concrete structures.

C. Submit qualifications, name, address, and key personnel information for the Contractor's Independent Testing Laboratory. The Contractor's Independent Testing Laboratory shall be licensed by the State of Maine.

E. All Contractor's Independent Laboratory Test results shall be sent by the lab directly to the Owner’s Representative.

F. Submit all reports with justification and limits for use or admixtures and changes to the water and cement ratio.

G. Submit key plans of locations of construction joints.

H. Submit copies of concrete batch and delivery tickets on day of delivery for each concrete delivery showing concrete mix proportion.

1.07 QUALITY ASSURANCE

A. The Structural Engineer on Record will conduct periodic reviews of the construction for compliance with the provisions of the Design Documents during the construction period.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Admixtures.

1. Air-entraining admixtures shall conform to ASTM Standard C 260. Provide "Darex AEA", "Vinsol NVX:, "Airecon", "Sika AER", or equal.

2. Chemical admixtures may act as high range water-reducing agents, super plasticizers, retarders, or accelerators, and shall conform to ASTM Standard C 494. Calcium chloride shall not be used as an admixture.

B. Aggregates. Aggregates for concrete shall conform to ASTM Standard C 33. Fine aggregate shall be inert natural sand. Coarse aggregate shall be well graded crushed stone or crushed gravel, size no. 67 for reinforced concrete 9 inches or less in thickness, size no. 467 for all other concrete. To be classed as crushed gravel, at least 50 percent of the fragments shall have a minimum of one face resulting from fracture. Nicked gravel will not be considered as crushed fragments. Provide a written request to the Owner for use of more than one source.

C. Anchor Slots and Inserts. Slots and inserts for anchoring mechanical items to concrete shall be of standard manufacture and shall engage with the anchors to be provided and installed therein under other Sections.

D. Cement. All cement shall conform to ASTM Standard C 150, Type II, except that high-early-strength cement.

E. Epoxy Bonding Compound. Epoxy bonding compound shall be a two-component epoxy-resin system conforming to ASTM C 881, Type II, Grade 2 for application to horizontal surfaces and Grade 3 for vertical surfaces, Class to match concrete substrate.

F. Epoxy grout shall be epoxy bonding compound mixed with aggregate recommended by the epoxy manufacturer.

G. Floor Hardener.

1. Dry shake floor hardener shall consist of specially processed, size-graded non-metallic aggregate, Portland Cement and inorganic pigment, and shall be "Colorcron" manufactured by Master Builders, "Harcol Redi Mixed" manufactured by Sonneborn, "Lithochrome Color Hardener" manufactured by Schofield Construction Specialties, or equal. Color shall be as selected by the Owner.

2. Chemical floor hardener shall be a colorless aqueous solution containing not less than two pounds of zinc or magnesium fluosilicate per gallon, or a sodium silicate solution having specific gravity of 16.7 Baume, or a pre-manufactured hardener manufactured by "Lapidolith", "Saniseal", "Hornolith", or equal. Pre-manufactured hardeners shall be delivered ready for use in the manufacturer's original containers.

H. Formwork. Provide in accordance with Section 031000.

I. Joint Sealer.

1. Joint sealer shall be a two-component cold-applied sealing compound conforming to Federal Specification TT-S-227B, or ANSI Standard A116.1. Type and class shall be compatible with continuous exposure to sewage. Joint details indicated shall be modified to suit the requirements of the sealant used.

J. Reinforcement. Provide in accordance with Section 032000.

K. Wire Fabric. Provide in accordance with Section 032000.

L. Water. Mixing water for concrete shall be clean, fresh, and potable.

M. Non-shrinking Grout. Non-shrinking grout shall be "Embeco 636" or "Embeco 153" manufactured by Master Builders, "Ferrolith G" manufactured by Sonneborn Conteck, "Firmix" manufactured by the Euclid Chemical Co., or equal.

N. Dust Proof Sealer (DPS). Provide Sonothane by Sonneborn Building Products Division of Contech, Inc.; Polytok Coating MC by Toch Brothers Division of Carboline Company; Tufthane by Tremco Manufacturing Company; or equal.

O. Moisture Barrier: Provide moisture barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows:

1. Reinforced Polyethylene sheet not less than 6 mils thick.

2.02 TESTING

A. General. Testing of aggregates, proposed mix designs, and concrete, for compliance with the Specifications will be performed by the Contractor's Independent Testing Laboratory. Additional tests required because of changes in materials or proportions, requested by the Contractor, will be performed at no additional cost to the Owner.

B. Cement and Other Mill Tests. Certified mill test reports covering all cement shall be submitted by the Contractor for review prior to the use of these materials. The tests shall cover requirements specified herein. Samples shall be furnished by the Contractor for independent tests to be performed at no additional cost to the Owner.

C. Tests of Aggregates and Concrete.

1. Advance data. Before any concrete is placed, the Contractor shall submit the following information:

a. Name of proposed concrete supplier (ready-mixed).

b. Proposed type and brand of cement. (Use of more than one brand is not permissible for exposed concrete surfaces.)

c. Proposed source of fine and coarse aggregate. (Use of more than one source is not permissible without advance approval.)

d. Proposed admixtures.

e. Proposed mix proportions for each class of concrete as indicated.

f. Previous test data for proposed fine and coarse aggregate and for concrete made from the same materials, if available.

g. Submit the results of ASTM C 1260 alkali silica testing of fine and coarse aggregate every 3 months.

2. Alternate sources. Concurrent tests of alternate sources of aggregates will be made at no additional cost to the Owner. If the first source submitted is rejected, subsequent tests shall be performed at no additional cost to the Owner.

D. Testing During Construction. The following tests shall be performed by the Contractor's Independent Testing Laboratory during construction:

1. Weekly aggregate tests at the mixing plant, scale tests, inspection of batch measurements and mixing procedures. (The concrete supplier shall

delivery inspection slips from plant inspector to inspector at point of placement.)

2. Slump and entrained air tests at point of discharge for every 100 cubic yards of concrete.

3. Strength tests for concrete consisting of three or more compression (or flexure) specimens molded near the point of sampling, stored for one day at point of molding with temperature and moisture conditions in accordance with ASTM C 39, laboratory-cured, and tested at 7 and 28 days. Not less than one set of specimens will be made for each 100 cubic yards of concrete or fraction thereof placed in any one day, and for each separate mix design.

4. Provide all labor for sampling and testing. Furnish in accordance with ASTM C 39 molds and plastic bag covers for making compression specimens, facilities for storage and curing of specimens in accordance with ASTM C 39 and deliver day-old specimens to the Contractor's Independent Testing Laboratory. At the mixing plant, facilities for sampling and testing gradation and moisture shall be provided. The Contractor shall at all times keep the Owner's Representative informed as to his concrete placement schedule two days in advance.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Proportioning. Proportioning of all concrete mixtures shall be subject to the review of the Owner's Representative and no concrete shall be placed without such review. (See Paragraph 2.02.C.) Proportioning shall conform to the recommendations of ACI 211.1 and ACI 301. Proportions shall be selected to meet all the requirements of specified standards and to produce a mixture which will work readily into the forms and around reinforcement by the methods of placing employed, but without permitting segregation of materials or collection of excessive free water at the surface.

Proportioning shall provide concrete with following properties:

Compressive strength	4000 psi minimum
Maximum water/cement ratio	0.44
Slump	1 to 4 inches
Air entrainment	4 to 6 %

1. Strength. Concrete shall develop a minimum compressive strength as indicated at 28 days cure unless otherwise noted. Strength requirements are based on 28-day compressive strengths except for high-early strengths, which are based on 7-day compressive strengths.

2. Air content. All exterior concrete shall be air entrained. Air-entrained concrete may be used elsewhere, at the option of the Contractor. Air-entrained concrete shall be produced by adding the air-entraining admixture to each batch at the mixer. The air content of freshly mixed air-entrained concrete shall be within the limits indicated as percent of the volume of the concrete.

3. Slump. The slump of concrete (ASTM C 143) shall be within the normal limits indicated and mixtures shall be proportioned to provide for that range without exceeding the maximum water-cement ratio. If higher slump is needed, submit justification for Owner's review prior to implementation. High Range Water Reducers – superplasticizers shall be used in accordance with the manufacturer's recommendations. During the course of concrete placement, it will be necessary to reduce slump as the depth of fresh concrete increases, subject to review by the Owner. Concrete delivered with slump outside the normal limits will be rejected by the Owner.

4. Admixtures.

   a. Admixture for water reduction may be used in all concrete, in the proportions recommended by the manufacturer, when requested in writing and reviewed by the Owner.

   b. Admixtures for retarding or accelerating the set may be used, at the option of the Contractor, in the proportions recommended by the manufacturer, when requested in writing and reviewed by the Owner.

5. The maximum water to cement ratio for the concrete shall be as indicated.

6. Adjustments during construction: Based on strength test results obtained as the Work progresses, adjust the maximum water-cement ratio and corresponding mix proportions to maintain specified strengths or to decrease consistently excessive strengths.

B. Formwork. Provide formwork in accordance with Section 031000.

C. Reinforcement. Provide in accordance with Section 032000.

D. Embedded Items. Embedded items shall conform with ACI 301 and all special requirements as indicated. Coordinate and verify the installation of all embedded items, including those furnished and/or installed by filed sub-bidders.

E. Insulation. Insulation shall be installed as indicated.

F. Concrete Mixing.

1. Ready-mixed concrete shall conform to ASTM Standard C 94. The mixing and transporting equipment and the method of placement shall be subject to the review of the Owner.

2. Mixing of all other concrete shall conform with ACI 301.

G. Placing. Placing of concrete shall conform with ACI 301. In all cases, the Contractor shall give the Owner a minimum of 48 hours notice of intended concrete placement and no placement shall begin until the Owner has approved the condition of foundations, forms, reinforcement, and embedded items.

1. Thoroughly wet down the subgrade in advance of the placing of the concrete. There shall be no puddles or pockets of mud when the concrete is placed.

2. Clean the earth foundation upon which concrete is to be placed such that it is free from debris, frost, ice and standing or running water. Prior to placing concrete, level and compact the earth foundation.

3. Before depositing new concrete on concrete that has set, roughen and clean the surfaces of the set concrete to be free of laitance, foreign matter and loose particles. Saturate the set concrete with water and, after free or glistening water disappears, slush the surface of the set concrete with a coat of grout. The grout coat shall be well scrubbed in by means of stiff brushes wherever possible. No concrete shall be placed before the grout coat has attained initial set. Grout shall consist of one part cement and one part sand with only a just amount of water to provide workability.

a. When the surface of old concrete is inaccessible, place the grout to spread it over the entire surface as the concrete is deposited.

b. Where "Epoxy Grout" is indicated use epoxy resin grout in strict accordance with the directions of the manufacturer.

H. Non-shrinking Grout. Grout for setting equipment bases, and wherever non-shrinking grout is indicated, shall be used in strict accordance with the manufacturer's directions.

I. Repair of Surface Defects. Proceed with the repair of defects in formed surfaces and filling of the holes immediately after the removal of forms (See Paragraph 3.01.B). Conform with ACI 301 requirements, except that, when approved by the Owner, honeycombed surfaces may be repaired by filling the voids without prior removal of concrete. All fins and projects shall be removed and irregular areas smoothed with carborundum stones.

1. Voids left by entrapped air or water bubbles at formed surfaces (sometimes covered by a thin film of mortar) shall be exposed by a wire brush and filled. For surfaces below finish grade, only repair honeycomb and fill tie holes.

J. Finishing of Formed Surfaces. Proceed with finishing of formed surfaces concurrently with, or immediately after, the repair of surface defects in conformance with ACI 301. Finish related unformed surfaces, such as tops of walls, by initially placing an excess of fresh concrete at the top of the form, striking off the excess with wooden tools, and forcing coarse aggregate below the surface before final floating. Crown such surfaces (if horizontal) slightly to provide drainage. No addition of mortar topping or retempering of concrete to facilitate finishing will be permitted. Provide grout cleaned finish conforming to ACI 301 on all interior exposed concrete, except slabs, and on all exterior vertical surfaces to 6 inches below grade.

K. Flatwork: Flatwork includes slabs on grade, framed slabs, and other flat concrete surfaces. Flatwork shall conform with ACI 301 and ACI 302.1R.

1. Floor hardener. Apply floor hardener to areas indicated. Apply the floor hardeners as follows:

a. Apply chemical floor hardener after the floors are thoroughly cured and perfectly dry with all other work above them completed.

1) Apply zinc or magnesium fluosilicte evenly, using three coats and allowing 24 hours between coats. The first coat shall be 1/3 strength, the second coat ½ strength, and the third coat 2/3 strength. Each coat shall remain on the concrete surface for 15 minutes.

2) Apply sodium silicate evenly, using three coats, allowing 24 hours between coats. Apply the sodium silicate full strength at the rate of 1/3 gallon per 100 square feet.

3) After inspection by the Owner’s representative apply concrete hardener in conformance with the Manufacturer's instructions.

b. Apply dust proof sealer after concrete is fully cured in accordance with manufacturer's printed instruction.

L. Curing and Protection. Curing and protection of concrete shall conform with ACI 308. Cure concrete to retain moisture and maintain a temperature of at least 50 degrees Fahrenheit at the concrete surface for a minimum of 7 days after placement.

3.02 EVALUATION OF CONCRETE STRENGTH

A. Concrete strength shall conform with ACI 301 and ACI 214. When the strength of laboratory-cured test specimens meet the requirements no other tests of hardened concrete will be required. If the strength of test specimens are unsatisfactory, the areas of concrete represented shall be subject to additional tests, at no additional cost to the Owner.

3.03 ACCEPTANCE OF STRUCTURES

A. The acceptance of completed concrete Work will be governed by the Provisions of ACI 301.

3.04 CONTRACT CLOSEOUT

A. Provide in accordance with Contract requirements.

END OF SECTION 033000

SECTION 042000

UNIT MASONRY, GENERAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions all other Technical Specifications Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The location of each type of unit masonry work is shown on the Drawings. In general, the work includes the following:

1. CMU walls and applied weatherproofing.
2. Brick facing and precast concrete sills.
3. All ties, reinforcement and anchors required for securing all masonry work together and to adjacent work, except as otherwise specified.
4. All through-wall metal and fabric flashing.
5. Rigid cavity wall insulation and loose fill CMU insulation.
6. Setting and/or building in all flashing, frames, windows, blocking, loose steel lintels, plates, anchors, bolts, ties, sleeves, door and frame, access doors, and all other items requiring building into work of this section.
7. Cutting and patching of work in this section as required for the work of other sections.
8. Cleaning and pointing.
9. Submission of samples and shop drawings as specified or otherwise requested by the Engineer.
10. Construction of one sample masonry panel for each type of masonry to be used, for Engineer's approval. Each panel will measure approximately 4'-0" x 4'-0".

B. Masonry Mortar and Grout are specified in Section 042000.12.

C. Masonry Accessories and Precast Concrete Sills are specified in Section 042000.13.

D. Brick Masonry is specified in Section 042113.

E. Concrete Masonry Units are specified in Section 042200.

1.03 QUALITY ASSURANCE

A. Comply with provisions of following codes, specifications and standards, except as otherwise indicated.

1. "BIA Technical Notes on Brick Construction", except as herein modified.

2. "Building Code Requirements for Engineered Brick Masonry" from the "BIA Technical Notes".

3. ACI 531 "Building Code Requirements for Concrete Masonry Structures".

4. ACI 531.1 "Specification for Concrete Masonry Construction".

5. ANSI/NBS H74 (A41.2) "Building Code Requirements for Reinforced Masonry".

6. ANSI/NBS 211 (A41.1) "Building Code Requirements for Masonry".

Where provisions of above codes and standards conflict with building regulations in effect for this Project, the building regulations will govern, but only to establish minimum requirements.

B. Coordination:

Review installation procedures and coordinate with other work that must be integrated with masonry.

C. Test for Masonry Materials:

Test prisms of materials in accordance with ASTM Standard E 447. The fully grouted prism strength shall be greater than 2700 psi.

Not less than three specimens shall be made for each initial preliminary test. Not less than three shall be made for each field test to confirm that the materials are as assumed in the design. The standard age of test specimens shall be 28 days, but seven-day tests may be used provided the relationship between the seven-day and 28-day strengths of the masonry is established by adequate data for the materials used.

Make at least three field tests during construction. Test specimen for grout shall be field formed in accordance with UBC Standard No. 24-22 (NCMA TEK 23A). The compressive strength of grout shall be determined by testing field formed specimen in a damp condition in accordance with applicable provisions of ASTM C 39.

D. Construction Tolerances:

1. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4 inch in 10 feet or one story.

2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4 inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.

3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2 inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.

4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls do not exceed minus 1/4 inch nor plus 1/2 inch from dimensions shown.

E. Job Mock-Up:

Prior to installation of masonry work, erect a sample wall panel mock-up using materials, bond and joint tooling required for final work. Provide special features as directed for sealant and contiguous work. Build mock-up at the site, where directed, parallel to finished wall of the building, of full thickness and approximately 4 feet long by 4 feet high, indicating the proposed range of color, texture and workmanship to be expected in the completed work, as well as sealants, flashing, insulation, ties, reinforcing, etc. Obtain the Engineer's acceptance of visual qualities of the mock-up before start of masonry work. Retain mock-up during construction as a standard for judging completed masonry work. Do not alter, move or destroy mock-up until work is completed.

1.04 JOB CONDITIONS

A. Materials Protection:

Protect masonry materials during storage and construction from wetting by rain, snow or groundwater and from soiling or inter-mixture with earth and other materials.

Do not use metal reinforcing or ties having loose rust or other coatings, including ice, which will reduce or destroy bond.

Protect grout and mortar materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

B. Protection of Work:

During erection, cover top of wall with heavy waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold cover securely in place. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

Prevent grout or mortar from staining the face of masonry to be left exposed or painted. Immediately remove grout and mortar in contact with such masonry. Protect sills, ledges and projections from droppings of mortar and other materials.

Take special care to keep the cavity between unit masonry wythe and backup material free of buildup which will act as a bridge for water penetration through the wall construction. Constant monitoring of this area shall be required to ensure that the bottom of the cavity does not fill with mortar droppings and that there is no mortar or other buildup between face wythe and backup construction. Method for preventing mortar droppings within the cavity shall be demonstrated for, and approved by, the Engineer.

C. Cold Weather Protection:

Remove all ice or snow formed on masonry bed by carefully applying heat until the top surface is dry to the touch. Remove all masonry determined to be frozen or damaged by freezing conditions.

D. Procedures Required During Construction:

Perform the following construction procedures while the work is progressing. When the outside temperature falls below 40°F during construction the temperature of the mortar shall be within a range of 70°F and a maximum of 120°F after all ingredients have been combined. The following construction requirements shall be followed to obtain the required mortar temperature.

When the outside air temperature is:

From 40°F to 32°F: Heat mixing water or sand to a minimum of 70°F and a maximum of 160°F.

From 32°F to 25°F: Heat sand and water to a minimum of 70°F and a maximum of 160°F, maintain temperature of mortar on boards above freezing.

25ºF and below: Heat sand and mixing water to a minimum of 70ºF and maximum of 160ºF; provide enclosures and auxiliary heat to maintain air temperature above 32ºF; do not lay units which have a temperature of less than 20ºF. Units shall be heated to about 40ºF to prevent sudden cooling of the heated mortar.

E. Procedures Required for Completed Masonry:

Perform the following for protection of completed masonry and masonry not being worked on.

When mean daily air temperature is:

From 40ºF to 32ºF: Protect masonry from rain or snow for at least 48 hours by covering with weather-resistive membrane.

From 32ºF to 25ºF: Completely cover masonry with weather-resistive membrane for at least 48 hours.

25ºF and below: Maintain masonry temperature above 32ºF for 48 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other acceptable methods.

PART 2 - MATERIALS

2.01 GENERAL

Refer to other sections of Division 4 for required masonry mortar, grout, masonry accessories, masonry units, face brick, and installation methods.

PART 3 - EXECUTION

3.01 INSPECTION:

Contractor must examine the areas and conditions under which unit masonry work is to be installed and notify the Authority's representative in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 PREPARATION

Except for absorbent units specified to be wetted by the manufacturer and approved by the Engineer, lay masonry units surface dry and adjust mortar mix to conform to the degree of water absorption for the individual masonry unit. Do not wet concrete masonry units. Use wetting methods which ensure that each masonry unit (except concrete masonry units) is nearly saturated but surface dry when laid.

3.03 INSTALLATION, GENERAL

Build cavity walls, composite walls, and other masonry construction to the full thicknesses shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

Build chases and recesses as shown or required for the work of other trades. Unless otherwise shown, provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

Cut masonry units using appropriate motor-driven masonry saws to provide clean, sharp, un-chipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full-size units without cutting wherever possible.

3.04 LAYING MASONRY WALLS

A. Mortar Types:

Unless otherwise indicated, use mortar as specified in Section 04100, "Masonry Mortar and Grout".

B. Batch Control:

Measure and batch materials by weight such that the required proportions for mortar can be accurately controlled and maintained. It is recommended that all batch materials be prepackaged to ensure consistency of proportions in the mortar mix. Measurement of sand by shovel will not be permitted.

Mix mortars with the minimum amount of water consistent with workability to provide maximum bond strength of the mortar.

Do not use mortar which has begun to set or if more than 2 hours has elapsed since initial mixing. Re-temper mortar during the 2 hour period only as required to restore workability.

Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

Lay-up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other work.

C. Pattern Bond:

Lay exposed masonry in the bond patterns indicated. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inch horizontal face dimensions at corners or jambs.

D. Mortar Bedding and Jointing:

To ensure that the cavities of walls are kept clean from mortar droppings, all bed joints adjacent to the cavity shall be beveled.

Lay solid brick size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

Lay solid concrete masonry units greater than 4" in thickness with divided bed joints unless full bedding indicated. Keep drainage channels (if any) free of mortar. Form head joints with sufficient mortar so that excess will be squeezed out as units are shoved into position. Butter both sides of units to be placed, or butter one side of unit-in-place and one side of unit-to-be-placed.

Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical faces of shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.

Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8 inch joints. Rake out mortar in preparation for application of sealants where shown and directed.

Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.

Tool exposed joints slightly concave unless otherwise indicated.

Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

E. Collar Joints:

Where shown, fill the vertical longitudinal joint between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging.

F. Stopping and Resuming Work:

Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

G. Built-in Work:

As the work progresses, “build-in” items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.

Fill space between hollow metal frames and masonry solid with mortar.

Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal screen lath in the joint two courses below the affected cell or cells, and rod grout into cores for four courses.

H. Horizontal Joint Reinforcing:

Refer to Section 04150 "Masonry Accessories" for type of materials required.

Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls and 1/2 inch on interior side of walls. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge control and expansion joints with reinforcing.

In single-wythe and multi-wythe walls (solid or cavity) where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by code but not more than 16 inches on center vertically.

Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcing placed in 2 horizontal joints approximately 8 inches apart, immediately above the lintel and immediately below the sill. Extend reinforcing a minimum at 2'-0" beyond jambs of the opening, bridging control joints only where indicated.

I. Corners:

Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

J. Intersecting and Abutting Walls:

Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and provide continuity with horizontal joint reinforcing using prefabricated "T" units.

K. Intersecting Load-bearing Walls:

If carried up separately, provide rigid steel anchors at not more than 2'-0" on center vertically. Form anchors of galvanized steel not less than 1- 1/2" x 1/4" x 2'-0" long with ends turned up not less than 2 inches or with cross-pins. If used with hollow masonry units, embed ends in mortar-filled cells.

L. Cavity Walls:

Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

Tie exterior wythe to back-up with truss type ties embedded in mortar joints. Refer to Section 04150 "Masonry Accessories" for type of ties required.

M. Anchoring Masonry Work:

Provide anchoring devices of the type shown and as specified under Section 04150 "Masonry Accessories". If not shown or specified, assume that anchoring devices are required and request a clarification from the Engineer before commencing masonry work.

Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:

Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar and other rigid materials.

Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise shown.

N. Expansion Joints for Exterior Brick Masonry:

Provide vertical expansion and isolation joints in brick masonry where shown. Build-in related items as the masonry work progresses. Refer to Section 079200, Joint Sealers.

O. Control Joints for Concrete Masonry Units:

Consult the Engineer for the location of control joints.

P. Lintels:

Provide steel lintels where shown, in accordance with Section 055000, Metal Fabrications.

Provide concrete masonry unit reinforced bond beams where shown in accordance with Section 042200 – Concrete Masonry Units.

Provide minimum bearing at each jamb of 4 inches for openings less than 6'-0" wide; 8 inches for wider openings.

Q. Flashing of Masonry Work:

Provide concealed flashings in masonry work at obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Concealed flashings shall be provided at, but not be limited to, the following locations:

- Wall base, continuous and above finish grade.
- Window sills.
- Above steel lintels, relief angles and shelf angles.
- Projections, recesses and caps.
- Top of walls.

Prepare masonry surfaces to be smooth and free from projections which could puncture flashing. Seal penetrations in flashing with approved mastic. Extend flashings the full length of lintels and shelf angles and minimum of 4 inches into masonry at each end. Extend flashing from 4 inches beyond exterior face of masonry, through the outer wythe, turned up a minimum of 4 inches, and through the inner wythe to within 1/2 inch of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches and adhere to face of interior wythe.

Where inter-backup is other than masonry, install flashing to conform to profile of shelf angle and extend a minimum of 8 inches up (and adhere to) the backup material.

Lap ends of flashings by overlapping a minimum of 6 inches and seal lap with mastic recommended by manufacturer.

Provide 8 inch high end dams at the termination of all non-continuous flashings. Also provide continuous vertical flashings at all wall openings.

Install elastic flashings in accordance with manufacturer's instructions.

Provide prefabricated PVC honeycomb weep joint inserts in the head joints of the first course of masonry immediately above all concealed flashings. Space 24 inches on center, unless otherwise indicated. Provide 1/4 inch diameter cotton rope weeps, returned 12 inches up back-up wall. Take care not to cover weeps with sealant or mortar.

Install nailers for flashing and other related work where shown to be built into masonry work.

3.05 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing:

During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar.

Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, and where required, properly prepared for application of sealant.

C. Cleaning Exposed, Unglazed Masonry Surfaces:

Wipe off excess mortar as the work progresses. Dry brush at the end of each day's work.

D. Final Cleaning:

After mortar is thoroughly set and cured, clean 1/2 of sample wall panel as follows. Obtain Engineer's acceptance of sample cleaning before proceeding to clean masonry work.

Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required and approved.

Presoak wall by saturating with water and flush off loose mortar and dirt. Scrub down wall with stiff bristle brushes and water mixed with the appropriate amount of one of the following masonry cleaners:

1. Vana-trol by Prosoco Inc.
2. Light duty Concrete Cleaner by Prosoco Inc.
3. EacoChem MND80 by EaCo Chem, Inc.

Rinse walls using clean, pressurized water, to neutralize cleaning solution and remove loose material. Acid cleaning of masonry will not be permitted.

Protect non-masonry surfaces from damage as necessary during cleaning operations. Restore all items so damaged to a like-new condition acceptable to the Engineer at no additional cost.

E. Protection:

Protect the masonry work from deterioration, discoloration and other damage during subsequent construction operations.

END OF SECTION

SECTION 042000.12

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

Masonry mortar for brick and concrete masonry unit are specified in this section.

1.03 QUALITY ASSURANCE

Do not change source or brands of masonry mortar materials during the course of the work.

1.04 SUBMITTALS

A. Manufacturer's Data:

Submit eight (8) copies of manufacturers' specifications and instructions for each manufactured product.

B. Samples:

Submit samples of each type of colored masonry mortar, showing the range of color which can be expected in the finished work. Label samples to indicate type and amount of colorant used. Engineer's review will be for color only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

PART 2 - MATERIALS

2.01 MATERIALS

A. Portland Cement: ASTM C 150, Type I, non-staining, without air entrainment and of natural color or white as required to produce the required color of mortar or grout.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregates for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100% passing the No. 16 sieve.

D. Aggregate for Grout: ASTM C 404.

E. Water: Clean, potable, free of deleterious materials which would impair strength or bond.

F. Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars. Do not exceed pigment-to-cement ratio, by weight, of 1-to-7. Subject to compliance with requirements, colored mortar pigments which may be incorporated in the work include, but are not limited to, the following:

1. Solomon Grind-Chem Services, Inc.; "SGS Mortar Colors".

2. Davis Colors, A Subsidiary of Rockwood Industries, Inc.; "True Tone Mortar Colors".

3. Similar colors manufactured by Bonsol Construction Products or Riverton Lime and Stone Co. are acceptable.

2.02 MORTAR MIXES

A. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents.

B. Do not use masonry cement.

C. Do not use calcium chloride or other antifreeze compounds in mortar or grout.

D. Mortar for Unit Masonry (Proportion by Volume Method):

Non-staining, cement-lime mortar complying with ASTM C 270, "Table 1, Proportion Specification Requirements", but limiting acceptable types to those listed below for cement-lime mixes.

1. Type M: 1/4 part lime per part of Portland Cement.

2. Type S: Over 1/4 up to 1/2 part lime per part of Portland Cement.

E. Use the following mortar mix for the applications indicated.

1. Use Type M mortar for masonry below grade and in contact with earth.

2. Use Type S mortar for other applications.

F. Colored Pigmented Cement Mortar:

Proportion pigments with other ingredients to match sample approved by the Engineer.

2.03 GROUT MIX

Portland cement, sand, gravel and water, proportioned as required to provide a 28-day minimum compressive strength of 2500 psi.

PART 3 - EXECUTION

3.01 Refer to Section 042000, "Unit Masonry, General" for required installation procedures of mortar and grout specified in this section.

END OF SECTION

SECTION 042000.13

MASONRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions other Technical Specifications Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. Section 042000, "Unit Masonry, General" specifies the installation of masonry work including the accessories specified under this section.

B. The location of the masonry work is shown on the Drawings. The types of masonry accessories required include the following:

Continuous horizontal wire reinforcing.

Vertical bar type reinforcing.

Anchoring devices for masonry.

Concealed flashings built into masonry work.

Control joint strips.

Masonry weep joints.

Full height cavity wall drainage mat.

Filler strips at tops of masonry partitions.

Drip Plates

Precast concrete sills.

Recessed Knox box.

1.03 SUBMITTALS

A. Manufacturer's Data:

Submit eight (8) copies of manufacturer's specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements.

B. Test and Engineering Data:

Submit eight (8) copies of certifications of load tests or engineering data substantiating capability of the anchors to withstand the imposed compression/tension loads.

PART 2 - MATERIALS

2.01 CONTINUOUS WIRE REINFORCING

A. Horizontal Wall Reinforcing: Extra heavy-duty (galvanized in accordance with ASTM A-153 at exterior walls and interior walls in humid and wet areas) continuous truss type in accordance with ASTM A-82. Provide preformed corner and intersection units. Vertical spacing of reinforcement courses shall be 16 inches on center unless closer spacing is shown on the Drawings. However, in all cases, place reinforcement in the first two course joints immediately over and under openings, extending not less than 48 inches on each side, and in bottom of three course beds, and the top course bed. Unit width shall be such that the side rods center on the walls of hollow masonry units. Reinforcing shall be Hohmann & Barnard, Inc. units listed below or approved equal products manufactured by Dur-O-Wall Products, Inc. or AA Wire Products Co.

1. Single Wythe: Hohmann & Barnard, Inc., "Truss Mesh" #120, 3/16 inch side rods, #9 cross rods, hot dip galvanized in accordance with ASTM A 123, Class B2.

2. Double Wythe and Cavity: Hohmann & Barnard, Inc., "#165-S.I.S." consisting of #165 Truss Box Mesh (3/16 inch side rods, #9 cross rods, 3/16 inch boxes); "Seismiclip"; 3/16 inch "Byna-tie"; 3/16 inch Continuous Wire; all hot dip galvanized in accordance with ASTM A 123, Class B2 except continuous wire to be mill galvanized in accordance with ASTM A 116/641, Class 3.

Note: Continuous wire reinforcement is required for all 4 inches thick (nominal) and wider units.

B. Masonry Anchors:

1. Masonry to Steel Stud: Hohmann & Barnard #DW-10 with 3/16 "Byna-Tie" and "Seismiclip", or approved equal by AA Wire Products Co. or Dur-O-Wall, Inc.

2. Masonry to Cast-in-Place Concrete: Hohmann & Barnard #305 Dovetail Slot, #315-BT Flexible Dovetail and "Seismiclip", or approved equal by AA Wire Products Co. or Dur-O-Wall, Inc.

Notes:

All materials shall be hot-dip galvanized in accordance with ASTM A 123, Class B2.

Continuous horizontal reinforcement (e.g., truss type and single wire type) shall be secured to each masonry anchor with "Seismiclips".

C. Masonry Partition Top Anchors: Refer to the Structural Drawings.

D. Rigid Steel Anchors: Hot dip galvanized 1 1/2" x 1/4" x 2'-0" long with ends turned up 2 inches in opposite directions or with acceptable cross pins.

2.02 FLASHING FOR MASONRY

Copper Fabric Laminated: Copper sheet weighing 5 ounces per square foot bonded with asphalt between 2 layers of glass fiber cloth. Flashing shall be manufactured by one of the following:

Copper Fabric; Afco Products, Inc.
Copper Fabric Flashing; Sandell Mfg., Co. Inc.
Copper Fabric Flashing; York Mfg., Inc.

Adhesive for flashing shall be as provided by the flashing manufacturer.

2.03 MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60, of the sizes shown.

B. Preformed Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and maintain lateral stability in masonry wall; size and configuration as indicated or required.

1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation M2AA-805

C. Weep Joints: Provide the following:

1. PVC Honeycomb: Provide 3/8” wide by height of bed joint prefabricated honeycomb units.

D. Full Height Cavity Drainage Mat: Provide ¾” thick by full height and width of all cavity wall spaces. Product shall be similar to CavClear Masonry Mat or Mortairvent CW.

E. Compressible Filler: Premolded filer strips complying with ASTM D1056, Type 2, Class A, Grade 1; compressible up to 35 percent; of width and thickness indicated; formulated from the following material.

1. Neoprene.

F. Drip Plate: Provide the following:

1. Manufacturer: Hohmann & Barnard, Inc. Drip Plate DP-FTSA
2. Width: 3”
3. Foam-Tite Seal Width: 2.5”

4. Material: Type 304 Stainless Steel (26 gauge)

2.04 PRECAST CONCRETE

A. Architectural precast concrete: Provide custom fabricated, integrally colored sills, complying with the following:

1. Compressive strength: 5,000 psi minimum at 28 days.

2. Entrained air: 5% - 6%.

3. Finish: Light sandblast finish approved by the Authority.

4. Formwork: Comply with applicable requirements of ACI 347, and with PCA forms of Architectural Concrete. Forms shall bear APA grade-trademark and shall have specially formulated aluminum edge sealer. Provide forms true, straight and square. Where joints occur in forms, the interior surface shall be flush. Forms shall be braced rigidly. Prior to each pour, coat forms with approved non-staining form release agent that will not interfere with adhesion of sealants, insulation adhesives or applied finishes.

5. Reinforcement: Provide reinforcement as shown on shop drawings and as specified herein. Provide additional reinforcement required for handling, transportation and erection stresses. Reinforcement shall be cold rolled steel complying with ASTM A 615, Grade 60, deformed and welded wire fabric conforming to ASTM A 185. Reinforcing steel shall be hot-dip galvanized after fabrication.

6. Detailing and fabrication of reinforcement shall conform to ACI 315 and ACI 315R.

2.05 KNOX BOX

A. Provide recessed KNOXBOX 3200 in black.

PART 3 - EXECUTION

3.01 INSTALLATION

Refer to Section 042000, "Unit Masonry, General" for installation of masonry accessories specified under this section.

END OF SECTION

SECTION 042113

BRICK MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions and other Technical Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. Brickwork is indicated on the Drawings. Installation of the face brick and common brick are specified in Section 042000, "Unit Masonry, General".

B. Masonry mortar and grout is specified in Section 042000.12, "Masonry Mortar and Grout".

C. Masonry accessories, including reinforcing, are specified in Section 042000.13, "Masonry Accessories".

1.03 QUALITY ASSURANCE

A. Obtain face brick from one manufacturer, of uniform texture and color (or uniform blend in the variation thereof).

B. Standards:

Facing Brick: ASTM C 216-75, Grade SW.

Building (Common) Brick: ASTM C 62.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit brick manufacturer's specifications and other data for each type of product required, including certification that each product complies with the specified requirements. Include instructions for handling, storage, installation and protection of each type of brick.

B. Samples:

1. Submit 5 samples of exposed brick. Include the full range of exposed color and texture to be expected in the completed work. Engineer's review will be for color

and texture only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

2. All brick when submitted for approval shall be accompanied by the manufacturer's statement of the following:

   Compressive strength of the brick which will indicate the degree of hardness.

   Certification that the brick submitted is Type SW (Severe Weather) brick.

   Special instructions for laying the brick, if any.

   Any modifications to the mortar mix which might be required for proper bond strength.

PART 2 - MATERIALS

2.01 MATERIALS FOR BRICK MADE FROM CLAY OR SHALE

A. At Contractor's option, provide solid brick, cored or uncored, for vertical brickwork. Do not use cored brick with net cross-sectional area less than 75% of gross area in the same plane or with core holes less than 3/4 inch from any edge.

2.02 BRICK TYPES

A. Face Brick: Comply with the requirements of ASTM C 216, Grade SW, Type FBS standard modular size brick shall be the following:

   Belden Brick: 503-505A

B. Building (Common) Brick: Conform to ASTM C 62, Grade SW.

PART 3 - EXECUTION

3.01 INSTALLATION

Refer to Section 042000 "Unit Masonry, General" for installation of brick.

END OF SECTION

SECTION 042200
CONCRETE MASONRY UNITS

PART 1 - DESCRIPTION

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION OF WORK

A. Extent of each type of masonry work is indicated on drawings.

B. Types of masonry work required include:

1. Face brick veneer- Specified in Section 042113 – Brick Masonry
2. Masonry waterproofing.
3. Concrete masonry units.

1.03 QUALITY ASSURANCE:

A. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementation’s component and from one source and producer for each aggregate.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

C. Store cementitious materials off the ground, under cover and in dry location.

D. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

E. Store aggregates where grading and other required characteristics can be maintained.

1.05 PROJECT CONDITIONS:

A. Protection of Work: Where exposed to weather during erection, cover top of masonry with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

C. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

D. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

E. Cold Weather Protection:

F. Do not lay masonry units which are wet or frozen.

G. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.

H. Remove masonry damaged by freezing conditions.

I. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation.

1. 40 deg F (4 deg C) to 32 deg F (0 deg C):

a. Mortar: Heat mixing water to produce mortar temperature between 40 deg F (4 deg C) and 120 deg F (49 deg C).

2. 32 deg F (0 deg C) to 25 deg F (-4 deg C):

    a. Mortar: Same as above.

3. 25 deg F (-4 deg C) to 20 deg F (-7 deg C):

    a. Mortar: Same as above.
    b. Heat both sides of walls under construction.
    c. Use windbreaks or enclosures when wind is in excess of 15 mph.

4. 20 deg F (-7 deg C) and below:

    a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg F (4 deg C) and 120 deg F (49 deg C).
    b. Masonry Units: Heat masonry units so that they are above 20 deg F (-7 deg C) at time of laying.
    c. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 deg F (4 deg C) for 24 hours after laying units.

5. Do not heat water for mortar to above 160 deg F (71 deg C).

J. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperatures ranges apply to anticipated minimum night temperatures.

1. 40 deg F (4 deg C) to 32 deg F (0 deg C):

    a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.

2. 32 deg F (0 deg C) to 25 deg F (-4 deg C):

    a. Completely cover masonry with weather-resistive membrane for at least 24 hours.

3. 25 deg F (-4 deg C) to 20 deg F (-7 deg C):

    a. Completely cover masonry with weather-resistive membrane and insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.

4. 20 deg F (-7 deg C) and below:

a. Except as otherwise indicated, maintain masonry temperature above 32 deg F (0 deg C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg F (4 deg C) for 48 hours.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS:

A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

B. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

C. Concrete Block: Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.

1. Grade N.

2. Prism Strength: (f'm) = 1500 psi.

3. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high x 8 thick (15-5/8" x 7-5/8" x 7-5/8 actual). Other special units of 16” length x 4” high x 4” thick (15-7/8 x 7-5/8 x 3-5/8 actual).

4. Type I, moisture-controlled units.

5. Exposed faces: Manufacturer's standard color and texture.

a. Where special finishes are indicated, provide units with exposed faces of the following:

1) All CMU blocks shall be manufactured with an integral liquid polymeric water repellant admixture. This admixture shall be equal to “Dry-Block” CMU admixture as produced by Grace Construction Products. The admixture product shall be compatible with the mortar admixture product utilized for the project. Reference the Mortar and Masonry specification section 04100.

6. Hollow Load-Bearing Block Units: ASTM C90, Type I – Moisture Controlled.

7. Solid Load-Bearing Block Units: ASTM C90, Type I – Moisture Controlled; normal weight.

2.02 BRICK UNITS:

A. Reference Section 042113 – Brick Masonry

2.03 PRECAST CONCRETE SILLS:

A. Reference Section 042000.13 – Masonry Accessories.

2.04 MORTAR MATERIALS:

A. Reference Section 042000.12 – Masonry Mortar and Grout

2.05 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES:

A. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:

B. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

C. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.

2. Wire Size for Side Rods: 0.1875" diameter.

3. Wire Size for Cross Rods: No. 9 ga.

4. For Single-wythe masonry provide type as follows with single pair of side rods:

a. Truss design with continuous diagonal cross rods spaced not more than 16" oc.

5. For Multiple-wythe masonry provide type as follows with single pair of side rods:

a. Truss design with continuous diagonal cross rods spaced not more than 16" oc. and number of side rods as follows:

1) Number of Side Rods for Multiple-wythe Concrete Masonry: One side rod for each face shell of concrete back-up and of concrete masonry facing wythe.

D. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. AA Wire Products Co.
2. Dur-O-Wal, Inc.
3. Heckmann Building Products, Inc.
4. Hohmann & Barnard, Inc.
5. Masonry Reinforcing Corp. of America.
6. National Wire Products Corp.

E. Brick Veneer Wall Ties and anchors: Reference Specification Section 04085 for specific masonry anchor wall tie requirements.

2.06 CONCEALED FLASHING MATERIALS

A. Copper Fabric Laminate: 5 oz. Copper sheet bonded with asphalt between 2 layers of glass fiber cloth.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. Afco Copper Fabric; Afco Products Inc.
b. Copper Fabric Flashing; Sandell Manufacturing Co., Inc.
c. Copper Fabric Flashing; York Manufacturing Inc.

2.07 MISCELLANEOUS MASONRY ACCESSORIES:

A. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18.

B. Non-Metallic Expansion Joint Strips: Premoulded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE41.

C. Weepholes: Medium density polyethylene, ¼”x4”.

D. Vents: Medium density polyethylene, ¼”x4”.

E. Cavity Mat: Reference Section 042000.13 – Masonry Accessories.

2.08 INSULATION:

A. Extruded Polystyrene Board Insulation: Rigid cellular polystyrene thermal insulation with closed cells and integral high density skin, formed by the expansion of polystyrene base resin in an expansion process to comply with ASTM C 578, Type IV; 5-year aged R value of 5 Btuh at 75o F, in manufacturer's standard lengths and widths, in thicknesses as indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Amofoam; Amoco Foam Products Company.
b. Foamular; UC Industries, Inc.
c. Styrofoam: The Dow Chemical Company.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.09 MASONRY CLEANERS:

A. Acidic Cleaner: Manufacturer's standard strength general purpose cleaner, designed for new masonry surfaces of type indicated; composed of blended organic and inorganic acids combined with special wetting systems and inhibitors; expressly approved for intended use by manufacturer of masonry units being cleaned.

1. Available Products: Subject to compliance with requirements, a product which may be used to clean unit masonry surfaces includes, but is not limited to, the following:

a. "Sure Klean" No. 600 Detergent; ProSoCo Inc.

2.10 MORTAR MIXES:

A. Reference Section 042000.12 – Masonry Mortar and Grout.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

A. Do not wet concrete masonry units.

B. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

C. Thickness: Build cavity and composite walls to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

D. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

E. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

F. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

G. Use dry cutting saws to cut concrete masonry units.

3.02 CONSTRUCTION TOLERANCES:

A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.

C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.

D. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.03 LAYING MASONRY WALLS:

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Rack back 1/2-unit length in each course. Do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

E. Built in work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be imbedded in cores of hollow masonry units, place a layer of galvanized metal lath in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 3 courses (24" minimum) under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

3.04 MORTAR BEDDING AND JOINTING:

A. Lay solid brick size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.

E. Tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated.

F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

G. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise indicated.

3.05 CAVITY WALLS

A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

B. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes of concrete masonry units. Install at not more than 16" oc vertically.

C. Use masonry anchors installed in mortar joints of brick veneer and back up masonry. Install at not more than 16" oc vertically and 24" oc horizontally.

D. Provide weepholes in exterior wythe of cavity wall located immediately above ledges and flashing, spaced not more than 24" oc.

E. Provide ventholes in exterior wythe of cavity wall located at or near the top of wall locations as well at directly below thru-wall flashing locations allowing ventilation to the lower wall cavity. Space not more than 24" oc and offset/stagger from all weep locations.

3.06 CAVITY WALL INSULATION:

A. On units of plastic insulation, install small pads of adhesive spaced approximately 12" oc both ways on inside face. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly together both ways. Press units firmly against inside of masonry.

1. Fill all cracks and open gaps in insulation with crack sealer recommended by insulation board manufacturer.

3.07 HORIZONTAL JOINT REINFORCEMENT:

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6".

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Reinforce walls with continuous horizontal joint reinforcing at 16" oc. vertically, unless specifically noted to be omitted.

D. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

E. Reinforce masonry openings over 12" wide with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and below the sill. Extend reinforcement a minimum of 24" beyond the jambs of openings except at control joints.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build in related items as the masonry work progresses.

1. Build in non-metallic joint fillers where indicated.

3.09 LINTELS:

A. Install steel lintels where indicated reference structural drawings for additional information.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels.

C. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

D. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.

E. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

3.10 FLASHING OF MASONRY WORK

A. General: Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through wall flashing on sloping bed of mortar. Seal penetrations in flashing with mastic before covering.

Extend flashings through exterior face of masonry and turn down to form drip.

B. Extend flashing the full length of lintels and shelf angles and a minimum of 4" into masonry at each end. Extend flashing from exterior face of masonry and turn up 8".

C. Turn flashing, fold and seal at corners, bends and interruptions.

3.11 REPAIR, POINTING AND CLEANING:

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

2. Protect adjacent surfaces from contact with cleaner solutions.

3. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

4. Acidic cleaner: apply in compliance with directions of cleaner manufacturer.

5. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "TEK" bulletins.

D. Protection: Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

3.12 WATERPROOFING:

A. Apply waterproofing to all exterior masonry only in accordance with manufacturer’s instructions at recommended spreading rates. Field Applied Water Resistive Barrier: Similar to Carlisle Barritech NP

B. Thoroughly clean masonry prior to applying penetrating sealers.

C. Do not apply penetrating sealers until masonry has cured for a minimum of 28 days.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

B. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings. All structural steel shall be hot dip galvanized after shop fabrication to greatest extent possible.

C. Miscellaneous metal fabrications are specified elsewhere in Section 055000 Metal Fabrications. Refer to Section 033000 Concrete for anchor bolt installation in new concrete; chemical adhesive anchors used in existing concrete and stone are specified in this section.

D. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

Promptly remove and replace materials or fabricated components, which do not comply.

1.02 RELATED WORK:

A. MTA Specification Section 520: Structural Concrete

B. Section 055000: Metal Fabrications

C. Section 099123: Painting

1.03 REFERENCES:

A. American Institute of Steel Construction (AISC)

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued June 1, 1989.

3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

4. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".

B. American Society of Testing and Materials (ASTM)

1.	ASTM A 6	General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.
2.	ASTM A 123	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates and Hardware.
3.	ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware.
4.	ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners.
5.	ASTM A 325	High Strength Bolts for Structural Steel Joints.
6.	ASTM A 449	Quenched and Tempered Steel Bolts and Studs.
7.	ASTM A 500	Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
8.	ASTM A 501	Hot Formed Welded and Seamless Carbon Steel Structural Tubing.
9.	ASTM A 384	Standard Practice for Safeguarding against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
10.	ASTM A 305	Contractor's Qualification Statement.
11.	ASTM A 36	Specification for Carbon Structural Steel.
12.	ASTM F 593	Stainless Steel Bolts, Hex Cap Screws, and Studs.
13.	ASTM F 594	Specification for Stainless Steel Nuts.
14.	ASTM A 666	Specification for Annealed or Cold-Worked Austenite Stainless Steel Sheet, Strip, Plate, and Flat Bar.
15.	ASTM A 143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
16.	ASTM A 780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

17.	ASTM A 992	Structural Shapes for use in Building Framings.
18.	ASTM F 1554	Anchor Rods

1.04 DEFINITIONS: N/A

1.05 SYSTEM DESCRIPTION: N/A

1.06 SUBMITTALS:

A. Submit Shop Drawings prior to fabrication in accordance with Contract requirements. The Contractor shall have received and approved all submittals prior to review by the Engineer. All review by the Architect, Engineer and Contractor of submittals shall be completed prior to fabrication and installation of any material or product.

B. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports, notarized certificates and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts (each type) and stainless steel bolts, including nuts and washers.

3. Chemical adhesive anchors, including threaded rod, nuts, washers and adhesive capsule. Include certification of compatibility drinking (potable) water.

4. Structural steel primer paint.

5. Non-shrink, non-metallic grout.

6. Hot dip galvanizing process.

7. Calibration report for chemical anchor testing equipment

B. Shop Drawings:

a. Submit shop drawings prepared under supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams. Re-use of structural Contract documents as erection or detail drawings will not be permitted.

b. Include details of cuts, connections, camber, holes and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length and type of each weld.

c. The Engineer/Architect reserve the right to make revisions during the shop drawing review. These revisions shall be incorporated into the shop drawings at no additional cost.

1.07 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of codes and standards listed in Paragraph 1.03, unless otherwise indicated.

B. Qualifications for Welding Work: Quality welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

Provide certification that welders to be employed in work are satisfactorily passed AWS qualification tests.

If recertification of welders is required, retesting will be at no additional cost to the Owner's Representative.

C. Chemical Adhesive Anchor Field Testing; On-site testing of chemical adhesive anchors shall be performed by the manufacturer's representative at all sites. Two random tests shall be performed for each type of wall material (brick or stone masonry) at each site in general conformance to the testing procedure below. The costs for these tests shall be borne by the contractor. If test results fail to meet the required allowable design values shown on the Drawings by more that 50 percent (1.5 x allowable bond strength), the Consultant may request additional testing at no additional cost to the Owner's Representative. If these additional tests fail to meet the required design values, the contractor shall submit to the Consultant proposed methods of correcting the deficient anchors for his review. Material descriptions and required installation procedures are described elsewhere in this section.

Test Assembly: The test assembly for the chemical adhesive anchors shall consist of a 30-ton hollow core hydraulic ram and pump assembly with both 5,000 psi and 10,000-psi gages (submit calibration report) and a steel tripod 17 inches apart at the base. The Tripod is placed directly over the anchor bearing on the base material surface (not all anchors will be testable). The hollow core of the ram is placed on the seat of the tripod (which has a hole) and the pull is passed through both ram and seat, and is coupled to the anchor. The nut and washer attach the pull rod to the ram at its outermost end.

Test Procedure: Through hand pumping, gradually apply load to anchor. Based on the conversion system required to attain loading valves in kips (1,000 lbs.), apply load until it has reached a value 50 percent greater that the required allowable bond strength shown for the particular size anchor on the drawings, Two random tests (locations to be chosen by the Consultant) will be performed for each type of wall material at each site.

1.08 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, and chemical adhesive anchors in ample time so not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms or other supports. Protect steel members and packaged materials from erosion and deterioration.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replaced damaged materials or structures as directed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Structural Steel Shapes: ASTM A 992 and Plates and Bars: ASTM A 36, shall be chemically compatible with galvanizing, ASTM A 384 and A 305.

C. Cold Formed Steel Tubing: ASTM A500, Grade B.

D. Anchor Bolts: F 1554 GR 55, threaded stock unless otherwise indicated (see Paragraph 2.01 J for chemical adhesive anchors).

E. High-Strength and Stainless Steel Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts and hardened washers as follows:

Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325. Stainless steel bolts, nuts and washers shall be AISI type 316.

F. Electrodes for Welding: E7OXX or E316L - 16 (stainless) electrodes complying with AWS Code.

G. Non-shrink, Non-Metallic Grout: See Section 033000.

H. Hot Dip Galvanizing: Shall conform to ASTM B-6, with 0.5 percent nickel added to zinc.

I. Chemical Adhesive Anchors: Shall consist of an all threaded anchor rod, nut washer, and adhesive capsule. The composition of these components shall be as follows:

Anchor rods shall be manufactured from AISI Type 316 stainless steel meeting the requirements of ASTM 539-80. A chisel point of 90 degrees shall be formed or cut on the end of the rod to be embedded.

Nuts shall be manufactured from AISI Type 316 stainless meeting the requirements of ASTM F594 Group II.

Washers shall be manufactured from AISI Type 316 stainless steel and shall be the requirements of ASTM A666 Type 316 "1/4 Hard."

The Adhesive capsule shall consist of a sealed glass container, which contains all components of the adhesive mortar. These components shall consist of a vinylester (epoxy acrylate) resin, quartz aggregate, and a hardening agent. Within the capsule these

components shall be pre-measured and pre-proportioned in the exact volume and composition necessary for proper curing. These components shall be isolated from each other within the capsule such that curing shall not be initiated until such time that anchor installation occurs.

In 4,000 psi concrete (required values for masonry on drawings) at one capsule embedment, the adhesive shall provide the following ultimate and allowable bond strengths:

Diameter of Threaded Anchor Rod (inches)	Embedment (inches)	Hole Diameter (inches)	Ultimate Bond Strength (lbs.)	Allowable Bond Strength (lbs.)
3/8	3 1/2	15/32	9,070	2,420
1/2	4 1/4	9/19	12,460	3,330
5/8	5	11/16	19,010	5,070
3/4	6 5/8	7/8	27,230	7,260
7/8	6 5/8	1	32,070	8,550
1	8 1/41	1/8	45,070	12,290
1 1/4	12	1 1/2	97,260	25,940

It should be noted that the required allowable bond capacities shown on the Drawings are for embedment in masonry wall material and that their required bond strengths (tensile) are lower than the values shown above. Values for embedment in 4,000 psi concrete are listed for ease of comparison and availability of product data. Epoxy injection may be used in lieu of adhesive capsules.

2.02 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the Contract Drawings. Provide camber in structural members where indicated.

Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.

Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated. Bolt field connections, except where welded connections or other connections are indicated.

Provide high-strength or stainless steel threaded fasteners for all bolted connections.

C. High-Strength and Stainless Steel Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts," where indicated on the Drawing. Install stainless steel bolts where indicated on the Drawings.

D. Bolt Holes: Drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes n bearing plates.

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

2.03 PAINTING

A. General: Shop paint or field apply all structural steel coating systems, except those members to be hot dip galvanized in accordance with the coating manufacturer's written specifications and Section 099123 PAINTING.

Do not paint surfaces, which are to be field welded, or high-strength bolted with friction-type connections.

Apply 2 coats of paint to surfaces, which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

Field paint existing structural steel work indicated on the Drawings.

2.04 GALVANIZING

A. Steel members, shop fabrications and assemblies shall be hot dip galvanized after fabrication in accordance with ASTM A123. Safeguard against embrittlement in conformance with ASTM A143.

B. Do not treat galvanized surfaces with oils, grease or chemicals.

C. Do not apply paint primer to steel members, which are to be hot dip galvanized.

D. For repairs and touch-ups, apply over wire brushed surfaces, zinc rich paint (95 percent by weight) using a brush in accordance with ASTM A780. Dry film thickness of applied repair paint to be not less than coating thickness of required by ASTM A123.

PART 3 - EXECUTION

3.01 ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

B. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

Set loose and attached base plates and bearing plates for structural members or wedges or other adjusting devices. Use leveling nuts when setting column bases.

C. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

D. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

E. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

Level and plumb individual members of structure within specified AISC tolerances.

Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service. Splice members only where indicated on contract drawings.

F. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

G. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint of surfaces adjacent to field welds.

Do not enlarge undersized holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.

H. Gas Cutting: Do not use gas cutting torches in field for correction fabrication errors in primary structural framing. Cutting will be permitted only on secondary members, which are not under stress, as appearance when permitted.

I. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

J. Chemical Adhesive Anchor Installation:

The installation procedure shall be strictly as per manufacturer's instructions. Additionally, the following steps shall be taken:

All holes shall be fully cleaned using a nylon brush and compressed air. The holes shall be covered in such a fashion that they remain free of all debris until such time that anchor installation occurs.

The hole depth shall be equal to the length of the adhesive capsule unless otherwise indicated on the Drawings. In all cases, the volume to the mixed adhesive shall be at least equal to the

volume between the threaded rod and the hole wall. In no case shall the hole depth be less than the adhesive capsule length.

The hole diameter shall be exactly as recommended by the manufacturer.

The adhesive capsules shall be placed in the cleaned holes and the anchor rods shall be driven into them using a rotary hammer drill set to "rotary and hammer" mode. Full embedment shall be assured. The manufacturer's recommended cure time shall be allowed to elapse prior to any loading of the anchor bolt.

3.02 QUALITY CONTROL:

A. Owner’s Representative's Consultant will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

Testing agency shall conduct and interpret tests and state in each report whether specimens comply with requirements, and specifically state any deviations therefrom.

Provide access for testing agency places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

Testing agency may inspect structural steel at plant before shipment; however, Owner’s Representative's Consultant reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

B. Correct deficiencies in structural steel work, which inspections and laboratory test reports have indicated to be not in compliance with requirements at no additional cost to the Owner. Perform additional tests, at no additional cost to the Owner, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

END OF SECTION 051200

SECTION 055000

METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions and other Technical Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The work includes furnishing all materials, equipment, labor, supervision, design and drafting services, and fabricating, painting and performing all operations necessary to complete the metal fabrication work as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work. Metal fabrication includes items made from iron, steel and aluminum shapes, plates, bars, strips, tubes, pipes and castings which are not specified elsewhere.

B. Without in any way limiting the scope of work, the following major items are mentioned:

1. Aluminum bar grating frame.

2. Welded support fabrications.

3. Various anchors for installing/setting in concrete and masonry.

4. Lintels.

5. Shop painting of all ferrous items unless otherwise specified.

6. Gable Louvers.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following (latest edition including all amendments), except as otherwise indicated:

The State of Maine Building Code.

AISC "Code of Standard Practice for Steel Buildings and Bridges".

AWS D1.1 "Structural Welding Code".

ASCE-7 "Minimum Design Loads for Buildings and Other Structures".

NAAMM "Standard Specifications for Metal Bar Grating and Metal Bar Grating reads" and "Metal Bar Grating Manual".

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure". Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

C. Field Measurements: Where possible, take field measurements prior to preparation of shop drawings and fabrication. Do not delay job progress; allow for field trimming and fitting where taking field measurements before fabrication might delay work.

D. Shop Prefabrication/Assembly: Prefabricate/preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

E. The work specified under this Section shall be performed by firms that have been engaged in the satisfactory manufacture and fabrication of work of the same type and magnitude as specified herein for a period of at least five years.

1.04 SUBMITTALS

A. Product Data: Submit copies of manufacturers' specifications, anchorage/ installation details and installation instructions for products to be used in miscellaneous metal fabrications, including paint and grout products.

B. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor bolts, etc., to be installed by others.

Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties, and other information needed for structural analysis.

Any discrepancies in the Engineer's Drawings shall be brought to the attention of the Engineer for adjustment. The Contractor shall verify field dimensions with those dimensions given on the Engineer's Drawings, and obtain by measurement at the site all necessary dimensions and levels dependent on construction in-place.

Prior to submission of the shop drawings to the Engineer, they shall be pre-checked by the Contractor for conformity of detail with the Contract Documents and site conditions, and shall be coordinated with other work on the Project as necessary. The signature of a representative of the Contractor indicating that the shop drawings have been pre-checked will be required. The Contractor shall be wholly responsible for the

conformity of dimensions and details of the shop drawings with the Contract Documents and site conditions.

After receipt of the shop drawings by the Engineer, they will be reviewed and necessary revisions will be marked on the sepias which will be returned to the Contractor. Revisions shall then be made and the shop drawings resubmitted. This procedure will be continued until the shop drawings are released for construction. The Contractor shall then deliver to the Engineer one transparency and three prints for his record and the use of his personnel.

At least one copy of each released shop drawing shall be kept available in the Contractor's field office; shop drawings not bearing evidence of release for construction by the Engineer shall not be kept on the job.

C. Samples: Submit 2 sets of representative samples of materials and finished products. Also include a sample weld connection.

D. Design Calculations: The Contractor shall provide written verification that a registered engineer in the State of Maine has designed connections to supporting structures, and all other structurally related items.

1.05 DELIVERY AND STORAGE

A. Upon delivery to the jobsite or storage site, the miscellaneous metal fabrications shall be carefully unloaded and stacked at least 1 foot above the ground in such a manner as to provide ready surface drainage and adequate air circulation. All members exhibiting defective coatings, scars, abrasions, poor surface preparation, etc., shall be remedied by the Contractor to the satisfaction of the Engineer prior to placing items in storage or, if in the Engineer's opinion, such damaged items cannot be satisfactorily repaired, said items shall be promptly removed from the site and replaced with new items meeting the Engineer's satisfaction.

B. Deliver items to the site in a sequence that will allow the work to proceed without delay but will avoid long term storage of items at the site.

PART 2 - MATERIALS

2.01 MATERIALS

A. Metal Surfaces: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names and roughness.

B. Steel Plates, Shapes and Bars: ASTM A 36.

C. Aluminum: All structural extrusions shall be 6063-T6; all other extrusions shall be 6063-T5.

D. Expansion Bolts: Stainless steel "Kwik Bolts" as manufactured by Hilti Fastening Systems or approved equal.

E. Non-Shrink, Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non- corrosive, non-gaseous grout complying with CRD-C621. Provide grout specifically recommended by manufacturer for interior and exterior applications required.

F. Welding Rods: Conform to AWS Specification AWS D1.1.

G. Fasteners:

Provide stainless steel fasteners for exterior use and where built into exterior walls. Only non-magnetic stainless steel fasteners and washers shall be used where the fastener or washer will be in contact with aluminum.

H. Paint:

Metal Primer Paint: Except as otherwise noted, apply the following Tnemec primer, or approved equal by PPG, Devoe or DuPont to all non-galvanized ferrous surfaces.

1. Tnemec Series 10-99 Modified Alkyd Rust Inhibitive Primer, 3 dry mils, spray applied.

I. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds and abrasions in galvanized steel, complying with Military Specifications MIL-P-21035 (Ships).

2.02 FABRICATION

A. Workmanship:

Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished products for the use intended, using proven and acceptable details of fabrication and support.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

All holes indicated on the Drawings necessary for the installation of anchors shall be made as part of the work of this Section. No holes other than as indicated on the Drawings shall be drilled, punched or cut without the approval of the Engineer. Holes shall not be made by burning.

Material and workmanship shall at all times be subject to the approval of the Engineer.

Thickness of metal and details of assembly and anchors shall provide ample strength and stiffness with anchors concealed where possible. Provide waterproof joints where metal is exposed to the weather. Provide holes and connections for the work of other trades.

B. Codes and Regulations:

All fabrications intended for personnel walking, climbing, guarding and working surfaces, and the installation thereof, shall meet the requirements of the Department of Labor Occupational Safety and Health Standards and all State and local codes. In the event of conflicting requirements, the more stringent or conservative shall apply. All such work shall be stamped by a Professional Engineer registered in the State of Maine.

C. Galvanizing:

Provide a zinc coating for those items shown or specified to be galvanized, as follows:

ASTM A 153 for hot-dip galvanized iron and steel hardware.

ASTM A 123 for hot-dip galvanized iron and steel products.

D. Shop Painting:

Shop paint miscellaneous metal work, except surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated. Shop paint the portions of embedded steel to be exposed, and for an additional 2 inches below the exposed portion. Surface preparation and painting shall be performed in accordance with all applicable requirements of Section 09900.

"Commercial Blast Clean" welded support fabrications in accordance with Steel Structures Painting Council (SSPC) SP-6. For ferrous items, clean off heavy rust, loose mill scale, other deleterious materials in accordance SSPC SP-3 "Power Tool Cleaning".

Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning" prior to performing any other surface preparation procedures.

Immediately after surface preparation, apply primer in accordance with manufacturer's instructions at a rate to provide a uniform dry film thickness of 3.0 dry mils. Use

painting techniques which will result in full coverage of joints, corners, edges and all other surfaces.

Unless otherwise specifically indicated, apply one shop coat to all non-galvanized carbon steel fabricated items, except apply 2 coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

2.03 MISCELLANEOUS METAL FABRICATIONS

A. Rough Hardware:

Furnish conventional as well as bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing, supporting, anchoring or securing items to concrete, masonry and other materials.

Fabricate items to sizes, shapes and dimensions required. Furnish steel washers for heads and nuts.

B. Miscellaneous Framing and Supports:

Provide miscellaneous steel framing and supports which are not specified elsewhere, as required to properly complete the work.

Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive other work to be retained by framing. Fabricate from structural steel shapes, plates and bars of welded construction using mitered joints for field connections. Cut, drill and tap units as required. No burning of holes shall be allowed.

Hot dip galvanize all miscellaneous carbon steel frames, attachments, supports, etc., to be used in exterior applications and in exterior walls.

C. Aluminum Bar Grating:

Grating shall be pressure-locked type, 1 1/2 inch thick, with rectangular bearing bars. Fabricate grating to be flat, without warp, sized to fit in the utility pit recessed galvanized steel frame. Undercut grating 3/16 inch in both directions to facilitate periodic removal and reinstallation.

D. Brackets, Flanges, Fittings and Anchors:

Provide all types of brackets, closures, flanges, miscellaneous fittings and anchors which are not provided under other specification sections as necessary for the proper completion of the work.

Hot dip galvanize carbon steel members, fittings, brackets, fasteners, and other components for exterior applications and when used in and on exterior walls.

E. Loose Bearing Plates:

Provide loose bearing plates for steel items bearing on masonry or concrete construction, made flat, free from warps and twists, and of required thickness and bearing area. Drill plates to receive anchors and for grouting as required. Galvanize after fabrication.

F. Louvers:

Where indicated on the Drawings, install Airolite type K601D horizontal blade, sightproof louvers (inverted Y) with 4 inch deep blades. Blades and frame shall be extruded aluminum 12 gauge alloy 6063-T52, with "Kawneer 500" finish, custom color to match the windows and frames. Louvers shall be fitted with 16 gauge aluminum insect screen in extruded aluminum frames. The Contractor shall submit the manufacturer's data derived in accordance with AMCA Standard 500 on a 4 foot by 4 foot unit demonstrating that it provided a minimum of 4.11 square feet of free area and shall intake 600 fpm free area at a static pressure drop not exceeding 0.15 inch H_2O. Similar louvers by Construction Specialties, Inc. or Rusken Mfg. Div., Phillip Industries Inc. will be considered for use. Where indicated, detail and fabricate louvers so as to be readily removable from the secure side (interior). Provide full size blank-off interior panels at gable end louvers. Hollow metal frames shall be supplied under Section 08110.

PART 3 - EXECUTION

3.01 PREPARATION

Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to work performed at the site.

3.02 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including expansion anchors, anchor bolts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors, as required. Only expansion anchors are to be used for attaching items to masonry. All fasteners for exterior construction shall be Type 304 or 316 stainless steel.

B. Cutting, Fitting and Placement: The Contractor shall perform all measuring, detailing, cutting, drilling and fitting required to install miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from verified established lines and levels. Provide temporary bracing

or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

Fit exposed connections accurately together to form tight hairline joints. Field weld connections which cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat and galvanizing. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

C. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

D. Setting Loose Bearing Plates:

Clean concrete and masonry bearing surfaces and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

Set loose bearing plates on wedges. Position bearing members and tighten the anchor bolts. Do not remove wedges but cut-off flush with the edge. Use non-metallic, non-shrink grout, unless otherwise indicated.

Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

E. Install Louvers in accordance with the manufacturer's instructions and as indicated.

3.03 ADJUST AND CLEAN

A. Restore finishes damaged during installation so that no evidence remains of corrective work.

B. Touch-Up Painting: Immediately after erection, power tool clean in accordance with SSPC SP-3, field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum thickness of 2.0 dry mils of modified alkyd primer.

C. For Galvanized Surfaces: Thoroughly clean field welds, bolted connections and abraded areas and apply 2 coats of approved galvanizing repair compound.

D. Restore aluminum finishes as directed by the fabricator and approved by the Resident.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 – DESCRIPTION

1.01 DESCRIPTION OF THE WORK

A. This section covers wood blocking ad furring for masonry walls; wood nailers and blocking for roof fascias, flashing, and cants; wood framing; rough bucks for openings in masonry walls; wood framing for architectural casework and equipment; dressed wood grounds to receive plaster and other finish materials.

B. This section also addresses requirements for pressure treatment of wood for decay-resistant qualities.

C. The work covered by this Section includes, but is not necessarily limited to, the following:

1. Furnishing and installing all rough carpentry including miscellaneous grounds, blocking, sills, plates, shoes, shims, and furring, framing, framing anchors, and fasteners.

2. Soffit, fascia and rake framing.

3. Gable and overhang framing and sheathing.

4. Roof Sheathing.

5. Wood for other trades (i.e. blocking, nailers, grounds, etc.)

6. Furnishing and installing plywood wall back-up panels and back boards for telephone and electrical equipment and wood blocking required at back of fire extinguishers, electric panels, telephone panels, motor operators, wall stops, windows, toilet accessories, etc.

7. Drilling concrete and masonry and drilling and tapping of metal work as required for installation of rough carpentry.

8. And any other items of carpentry necessary to complete work properly.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Fabrications – Section 055000.

B. Finish Carpentry – Section 062013.

C. Thermal Insulation – Section 0721000.

D. Sheet Metal Flashing and Trim – Section 076200.

E. Joint Sealants – Section 079200.

1.03 SUBMITTALS

A. The following shall be submitted in accordance with the requirements of Section 01340 – Submittals and Substitutions:

1. Certificates of Compliance

2. Grade, species, and moisture content of wood-framing materials

3. Fastener (bolts, anchors, screws).

4. Wood-preservative treatment.

1.04 DELIVERY, HANDLING AND STORAGE

A. Wood materials shall be securely bundled and shipped with adequate moisture-resistant covers to preclude damage by weather or handling during delivery, when stored, and during construction.

B. Wood materials that must be stored outdoors before immediate use shall be placed in orderly piles and stored on blocks above ground. Lumber shall be stored in stacks with provision for air circulation within stacks. The material shall be protected from the elements with moisture-resistant covers.

PART 2 – PRODUCTS

2.01 WOOD MATERIALS

A. General

1. Each piece of framing lumber, board lumber and plywood shall bear the trademark and grade identification of the manufacturer's association or the authorized inspection bureau under rules of which the lumber is manufactured and graded.

2. Softwood lumber shall be seasoned S4S and Kiln-dried or air dried to the specified moisture content. Dressed sizes shall conform to USDC PS20.

3. Structural framing lumber shall be stress graded, with each piece being rated for strength and stamped to indicate the grade and fiber stress in manufacturer's certificate of inspection.

4. Moisture content shall conform to the rules of the lumber association or the inspection bureau under which the lumber is graded but shall not exceed 19 percent for boards and dimensional lumber and shall be marked “MC-19”.

2.02 STRUCTURAL FRAMING MATERIALS

A. All nominal 2 X 6 or smaller framing lumber unless otherwise noted, shall be #2 Spruce-Pine-Fir or better grade and shall have the following minimum allowable stresses:

B. All nominal framing lumber greater than 2 X 6, unless otherwise noted, shall be #2 Spruce-Pine-Fir or better grade and shall have the following minimum allowable stresses:

1. Extreme fiber in bending Fb = 1,000 psi.

2. Tension parallel to grain Ft = 600 psi.

3. Compression parallel to grain Fc = 675 psi.

4. Modulus of elasticity E = 1,300,000 psi.

2.03 SHEATHING, DECKING AND MISCELLANEOUS PLYWOOD

A. Sheathing shall be “Exterior” APA Performance – Rated Panels (C-D Exterior PS-1), 5/8” inch thick unless otherwise noted.

B. Miscellaneous plywood for interior applications, such as electric panel backing boards, shall be Interior DFPA C-D with exterior glue.

2.04 SOFFITS, FASCIAE AND RAKES

A. Fasciae, fasciae moldings, rakes and rake moldings shall be preservative treated custom grade solid Hem-Fir selected for its clear appearance, free of loose knots, large knots, pitch streaks, cupping etc., subject to approval by the Resident, fabricated to the shapes shown on the Drawings.

B. Soffits shall be sheathed with 5/8” thick plywood prior to installation of PVC finish panels.

2.05 FURRING

A. Furring shall be No. 1 Common Eastern Spruce of the sizes noted on the Drawings.

2.06 PRESERVATIVE TREATED LUMBER

A. The following wood members shall be pressure-preservative treated in accordance with FS TT-W-00571 and AWPB LP-2. Each piece shall bear the AWPB stamp, indicating point of treatment, preservative symbol, symbol of standard, date of treatment and moisture content after treatment:

1. Wood sills, plates, rough bucks and frames in exterior masonry wall openings.

2. Wall plates and furring in contact with exterior masonry or concrete.

3. Nailers that are set into, or are in contact with, concrete or masonry.

4. Blocking and nailers for roof deck, sub-fascia members, roof cants and saddles.

B. Preservative shall be either water-borne, conforming to AWPA P5, or oil-borne conforming, to AWPA P8.

C. Nailers to receive membrane waterproofing and wood members to receive finish materials shall be treated with a water-borne preservative to eliminate preservative bleed-through at nails.

D. Wood treated with oil-borne preservatives shall be clean, free from surface oil and properly seasoned for use.

E. Wood treated with water-borne preservatives shall be air dried or kiln-dried to reduce maximum moisture content to 15 percent.

F. The Contractor shall provide an affidavit signed by the preservative treatment company stipulating the moisture-retention obtained and certifying that for oil-borne, preservative-treated materials requiring paint or in contact with wood to be painted, the treated material conforms to the paintability, drying time and surface deposit requirements of FS TT-W-572 and that the moisture content for water-borne and preservative-treated materials does not exceed 15 percent upon shipment from the treatment plant.

G. Cut surfaces of preservative-treated material shall be brush coated with at least two coats of the same preservative used in the pressure treatment.

H. Treated wood exposed in the final structure shall be free from objectionable odors and shall not be harmful or corrosive to adjacent materials or anchorages.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Accurately and properly fit and brace all work and secure in position and direction. Framing, studding and blocking shall be as directed on the Drawings or as required by the work. Cooperate with all other trades as required. Use acoustical sealant along shoe and header of all party walls.

3.02 GENERAL FRAMING

A. All members are to be installed as shown on the drawings. when individual members have built-in camber, the members shall be placed with camber up.

B. No cutting of holes or notches in trusses for pipe, conduit or other reasons will be allowed.

C. All bearing surfaces shall be horizontal and even over the entire width of support.

3.03 PLYWOOD INSTALLATION

A. Plywood sheathing shall be installed with face-grain perpendicular to supports and be continuous over a minimum of two spans

B. End joints of sheets shall be staggered so that joints are not continuous along a support.

C. When framing members (including walls and roofs) are 24” or more on center, support edges of plywood sheathing perpendicular to and at midpoints between framing with metal “H” clips or solid blocking.

3.04 MISCELLANEOUS FRAMING REQUIREMENTS

A. All wood material in contact with concrete or masonry shall be given two coats of green Cuprinol wood preservative. Note: wood sills shall be pressure treated, not paintable treated.

B. Set all blocking required to erect all exterior and interior woodwork; cabinets; plumbing, electrical and mechanical equipment; rough bucks and blocking for roofing work.

C. Cutting and Patching – Do all cutting, patching, heading and blocking required for work of all trades. Notify Telephone Company to place jacks at rough-in stages.

D. Blocking and Supports – Install 2” nominal thick blocking of width necessary in stud partitions for anchoring all medicine cabinets, mirrors, towel bars, grab bars,

handrail brackets, and other items applied to or in the walls.

E. Backing Boards – Install ¾" plywood backboards for electrical and mechanical trades as required.

3.05 CLEAN-UP

A. Keep the premises and working surfaces in a neat, safe and orderly condition at all times during execution of this portion of the work.

1. At the end of each day, or more often if necessary, remove accumulation of sawdust, cut-ends and other debris to proper storage areas for disposal.

2. Upon completion of this portion of the work, thoroughly clean up the area.

END OF SECTION

SECTION 061753

SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SUMMARY

A. Work Included:

1. Designing, fabricating, supplying, and erecting wood trusses including steel connectors, gussets, and fasteners, galvanized.
2. Furnishing and installing lateral support of trusses as required.

1.02 RELATED WORK

A. Section 042000 – Unit Masonry, General
B. Section 061000 – Rough Carpentry

1.03 REFERENCES

A. ASTM Standards. The following standards of the American Society for Testing and Materials form a part of these Specifications. Unless otherwise specified, materials and methods of test shall conform to ASTM Standards.

1. A 90 Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
2. A25 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
3. E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

B. Miscellaneous Standards. The following standards form a part of these Specifications.

1. NFPA (National Forest Products Association) - National Design Specification for Stress Grade Lumber and Its Fastenings
2. PS (Product Standard) 20 - American Softwood Lumber Standard
3. AWPA (American Wood Products Association) C2 Standard - Pressure Treated Wood
4. TPI - Truss Plate Institute

1.04 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members which are fabricated from dimension lumber and have been cut and assembled prior to delivery to the Project site.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.05 SUBMITTALS

A. Submit Shop Drawings prior to fabrication in accordance with Contract requirements. The Contractor shall have received and approved all submittals prior to review by the Engineer. All review by the Architect, Engineer and Contractor of submittals shall be completed prior to fabrication and installation of any material or product.

1. Submit shop drawings indicating truss framing plans; species and grades of lumber used; design loading and allowable stress; force analysis of each member; pitch, span and spacing of trusses; gauge thickness, nominal sizes and locations of connectors at joints; bearing and anchorage details; framed openings; permanent bracing and bridging, fasteners, details of wind bracing, and all truss interconnections.

2. Shop Drawings and calculations shall be signed and stamped by a Professional Engineer licensed to practice in the State of Maine.

B. Submit manufacturer's instructions on lateral bracing.

1.06 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in TPI 1.

B. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

C. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

D. Source Limitations for Connector Plates: Obtain metal connector plates through one source from a single manufacturer.

E. Comply with applicable requirements and recommendations of the following publications:

1. TP1 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

F. Wood Structural Design Standard: Comply with applicable requirements in AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

G. Lumber used in the manufacture of trusses: Grade stamp clearly visible, including conformance with NFPA.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with TPI recommendations to avoid damage from lateral bending, overturning or other cause for which truss is not designed to resist or endure. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

C. The Contractor and Fabricator shall coordinate all shipping options, access to site, and erection procedures.

1.08 SEQUENCING AND SCHEDULING

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 PRODUCTS

2.01 GENERAL

A. Metal-Plate-Connected Wood Trusses shall be fabricated in an enclosed structure under controlled conditions by an experienced fabricator. The Truss fabricator shall verify all dimensions in the field prior to commencing fabrication. Trusses shall not be fabricated until all shop drawings have been approved.

B. The Truss fabricator shall design the Trusses based on the design loads and the configuration given on plans. Truss configurations shown are diagrammatic only. Final configurations and connections to be determined by truss manufacturer.

C. The Truss fabricator shall select the gusset plate to be used at each joint as well as plates required to field-splice Truss. All plates must have a working capacity of at least 125% of the design loads.

D. The Truss manufacturer shall account for the combined effects of bending and axial stresses in chord members due to uniformly applied loads.

2.02 MATERIALS

A. Wood Chords and Webs: PS 20, graded to NFPA rules, No. 1 structural grade, spruce-pine-fir, maximum moisture content of 16%.

B. Plates: Hot-Dip Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180) coating designation; Designation SS, Grade 33, and not less than 0.036 inch (0.9 mm) thick.

C. Nails: FS FF-N-105, Type 304 stainless steel.

D. Metal Framing Anchors: Provide framing anchors made from metal indicated and as follows:

1. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
2. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall plate below.
3. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick. Clip is fastened to truss through slotted holes to allow for truss deflection.

E. Lateral Support: As recommended by truss manufacturer and applicable codes.

F. Miscellaneous Materials:

1. Protective Coatings: SSPC-Paint 16, coal-tar epoxy-polyamide paint.

2.03 FIRE RETARDANT TREATMENT

A. All trusses shall be pressure treated with fire retardant chemicals according to AWPA Standard C 20.

2.04 FABRICATION

A. Ensure members are accurately cut to length, angle and true to line to produce close fitting joints with wood-to-wood bearing in assembled units.

B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required for types of joint designs indicated.

C. Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.

D. Design and fabricate trusses in multiple pieces where required for transportation limitations, to be field-spliced.

2.04 ACCESSORIES

A. Hurricane Ties.

B. Fasteners.

C. Blocking and Bracing.

D. Hangers.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. Before installing, splice trusses delivered to Project site in more than one piece.

3.02 ERECTION

A. The wood and fabrication criteria of all prefabricated wood trusses shall meet with National Design Specification for Stress-Grade Lumber and its Fastenings by National Forest Products Association (latest revision); Timber Construction Standards, by American Institute of Timber Construction (latest revision); and Design Specification for Light Metal Plate Connected Wood Trusses, by Truss Plate Institute (latest revision).

B. Wood trusses shall be handled, installed and braced in accordance with "Handling, Installing and Bracing Metal Plate Connected Wood Trusses HIB-91" of the Truss Plate Institute. The Truss fabricator shall furnish a copy of this manual and ship it in a watertight container with the trusses.

C. Where field connections of truss sub-assemblies are necessary, the connections shall be in accordance with the details shown on the approved truss design shop drawings.

D. All trusses and other roof structural components shall be fabricated in properly equipped manufacturing facilities of a permanent nature. They shall be manufactured by experienced workmen. All trusses shall be fabricated under the strict rules of the Truss Plate Institute.

E. Fabricated trusses and sub-assemblies shall be handled with care so that they are not damaged.

F. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound framing system. All erection and permanent bracing shall be installed and components permanently and securely fastened before application of any loads to the trusses. Permanent bracing shall meet all requirements of HIB-91 and the working drawings and specifications, whichever are the more stringent.

G. All prefabricated wood trusses are to be installed in accordance with Bracing Wood Trusses Commentary (BWT-76), as published by the Truss Plate Institute.

H. Field erection of the trusses, including items such as proper handling, safety precautions, temporary bracing to prevent toppling or dominoing of the trusses during erection, and any other safe guards or procedures consistent with good workmanship and good building erection practices, shall be the responsibility of the General Contractor and/or the framing subcontractor.

I. All framing shall be performed in accordance with the Contract Drawings.

J. All framing shall be set accurately to required lines and levels, rigidly secured in place with all necessary bolts, nails, spikes and bracing.

K. All connections, anchors, tie-downs (hurricane/seismic ties), clips shall be approved connectors as required to meet the design loads. Shop drawings shall be submitted for Engineer's review before fabrication.

L. All trusses must be securely braced both during erection and after permanent installation. Bracing shall be furnished by truss fabricator.

M. Framing members shall not be cut, notched or bored without prior approval of Engineer.

N. Double trusses shall be used at all openings.

O. Plates shall be double and lapped at all corners.

P. Set and secure wood trusses level, plumb, and in correct locations.

Q. Ensure truss ends have sufficient bearing area.

R. Cutting and altering of members is not permitted.

3.03 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Protective Coating: Clean and prepare exposed surfaces of metal connector plates and anchors. Brush-apply one coat of protective coating.

1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 061753

SECTION 062013

FINISH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions and other Technical Specifications Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. Finish carpentry work is shown on Drawings.

B. Finish carpentry work includes, but is not limited to the following:

1. Composite PVC standing and running trim and sills at windows

2. Composite PVC panel soffits with soffit vents.

3. Composite PVC exterior standing and running trim.

1.03 SUBMITTALS

A. Product Data: Submit copies of manufacturer's specifications and installation instructions for each product required.

B. Shop Drawings: Submit copies of shop drawings showing location of each item, dimensioned plans and elevations, large scale details, installation procedures and requirements, attachment devices and other components.

C. Samples: Submit the following samples for each species and cut or pattern of architectural woodwork:

1. Composite PVC trim for opaque finish; 6" x 3/4" x 18".

2. Plywood for painted finish (including edge banding), 1 finished sample of each type, 12 inches' square.

3. Composite PVC soffit panels for opaque finish; 6" x ½" x 12".

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

Protect finish carpentry products during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

1.07 WORK NOT INCLUDED

A. Finishing of standing and running trim is specified in Section 099123 - Painting.

PART 2 - MATERIALS

2.01 BASIC MATERIALS AND FABRICATION METHODS

A. Except as otherwise indicated, comply with following requirements for architectural woodwork not specifically indicated as prefabricated or prefinished standard products.

B. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average moisture content range of 9% to 12% for interior work; 15% for exterior. Maintain temperature and relative humidity during fabrication, storage and finishing operations.

C. Interior Wood and PVC:

1. Concealed Solid Wood: Ponderosa Pine, Sugar Pine or Idaho Pine; No. 2 or better.

2. Interior Plywood - Painted Finish: Interior grade A-B DFPA Douglas fir with matching edge bands where edges are exposed.

3. Interior Composite PVC Trim – Painted Finish: Azek Trim, or similar as approved by Architect.

4. Interior Composite PVC Panel – Painted Finish: Azek Sheet, or similar as approved by the Architect.

F. Exterior PVC

1. Composite PVC Soffits - Painted Finish: Azek Sheet, or similar as approved by the Architect.

2. Composite PVC Trim - Painted Finish: Azek Trim, or similar as approved by the Architect.

G. Soffit Vents: Soffit vents shall be aluminum "Vent-a-Strip", Model 70 as manufactured by H.C. Products, Co., or approved equal.

H. Design and Construction Features: Comply with details shown for profile and construction of finish carpentry; and, where not otherwise shown, comply with applicable Quality Standards, with alternate details at the fabricator's option.

PART 3 - EXECUTION

3.01 PREPARATION

A. Condition finish carpentry to average prevailing humidity conditions in installation areas prior to installing.

B. Meet at the site prior to delivery of finish carpentry and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor, Resident and other Authority representatives; installers, painting, mechanical work and electrical work, and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with installation only when everyone concerned agrees that required ambient conditions can be properly maintained.

C. Deliver inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

D. Prior to installation of, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION OF WOODWORK

A. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including countertops); 1/16-inch maximum offset in flush adjoining surfaces; and 1/8 inch maximum offsets in revealed adjoining surfaces.

B. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

C. Anchor finish carpentry to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing’s, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

D. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners, and comply with Quality Standards for joinery.

3.03 INSTALLATION OF EXTERIOR SOFFITS & TRIM

All exterior soffits and trim shall be installed with tight, hair-line joints. Cut edges shall be back and edge sealed with clear sealer after all cuts are made (including those for soffit vents) and before installation. Joints in running material shall occur only at supports. Prior to installing, surfaces that will be inaccessible after installation shall be thoroughly back-primed. Fasteners shall be set below the finish surface and the holes filled and sanded smooth. Tri joints shall be mitered. Soffit panels shall have ship-lap joints. All soffit panels shall be secured to plywood soffit sheathing and roof framing structure.

3.04 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective work to eliminate functional and visual defects. Where it is not possible to repair items to the Resident's satisfaction, replace the work at no additional cost. Adjust joinery for uniform appearance.

B. Lubricate, make final adjustments for proper operation, and clean hardware.

C. Clean composite PVC exposed and semi-exposed surfaces. Touch-up finishes to restore damaged or soiled areas to the Engineer's satisfaction.

D. Refer to Section 099123 for final finishing of installed finish carpentry work and architectural woodwork.

E. Protection:

1. Protect finish carpentry during the remainder of the construction period to ensure that work will be without damage or deterioration at time of acceptance.

2. Cover completed work with protective covering as necessary to protect from damage, applied in a manner which will allow easy removal without damaging finish carpentry, or adjoining work. Remove coverings immediately before Final Acceptance.

END OF SECTION

SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions and other Technical Specifications Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The work includes furnishing of all labor and materials necessary to provide an installation which is complete in every respect and of the composition and quality as specified herein.

B. Applications of insulation specified in this section include, but are not limited to, the following:

1. Board type for perimeter slab and foundation walls.

2. Board type for masonry cavity walls.

3. Spray foam type for sealing around mechanical and electrical penetrations.

4. Batt type insulation at the bottom chords of roof trusses.

5. Loose masonry insulation for CMU voids.

C. The work also includes furnishing and installing polyethylene vapor retarders.

1.03 QUALITY ASSURANCE

A. Thermal Resistance: Where a minimum "R" value is given, provide thickness required to achieve indicated value.

B. Thermal Transmittance-Heat Transfer: Where a maximum "U" value is given for a wall assembly, provide thickness required to achieve indicated value.

C. Fire and Insurance Ratings: Comply with fire-resistance, flammability and insurance ratings indicated, and comply with regulations as interpreted by applicable codes and local authorities.

1.04 SUBMITTALS

A. Product Data: Submit eight (8) copies of the manufacturers' specifications and installation instructions for each type of insulation and vapor barrier material required.

B. Certified Tests: Submit eight (8) copies of certified test report showing compliance with specified performance values if submitted product is other than those specified.

1.05 PRODUCT HANDLING

Protect insulation from sunlight, from physical damage and from becoming wet, soiled, or covered with ice and snow. Comply with manufacturers' recommendations for handling, storage and protection during installation.

PART 2 - MATERIALS

2.01 MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to those listed below.

2.02 MATERIALS

A. Extruded Polystyrene Board Insulation: Rigid, closed-cell, extruded, polystyrene insulation board with integral high-density skin; comply with ASTM C 578, Type IV, achieve minimum compressive strength of 25 psi at 10% deformation per ASTM D 1621; achieve maximum moisture absorption of 0.3% by volume per ASTM C 272; 5-year aged R-value of 5 per inch at 75°F.

"SM", "TG" or "RM", Dow Chemical Co.
Formula 400, UC Industries/U.S. Gypsum

Expanded polystyrene insulation board is not acceptable.

Insulation boards less than 1" thickness shall be Type IV; 15 psi minimum compressive strength.

B. Unfaced Glass Fiber Batt Insulation: Thermal insulation produced by combining glass fibers with thermosetting resins to comply with ASTM C 665 for Type I and ASTM E 136.

C. Concrete Masonry Unit Insulation: Shall be loose fill vermiculite insulation treated for water repellency, conforming to ASTM C 516, Type II, equal to "Zonolite Masonry Insulation" by W.R. Grace & Co.

D. Spray Foam Insulation: Shall be “Great Stuff” by Dow Chemical Company, or similar as approved by the Architect.

E. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer and complying with fire-resistance requirements.

F. Mechanical Anchors: Type and size, as recommended by insulation manufacturer for conditions of application and substrates.

G. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

H. Vapor Retarder: 6 mil polyethylene film with laboratory tested vapor transmission rating of 0.2 perms, natural color. Provide manufacturer recommended, Engineer approved tape for sealing laps.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

Examine substrate and conditions under which insulation work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected in an acceptable manner.

Clean substrates of substances harmful to insulations (or vapor barriers, including removal of projections which might puncture vapor barriers).

3.02 INSTALLATION OF INSULATION

A. Comply with manufacturers' instructions for installation or consult manufacturer's technical representative for specific recommendations before proceeding with work.

B. Apply insulation (full thickness) over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation, taking care not to overly compress the insulation. Remove projections which interfere with placement.

C. Under-slab Insulation

Set units in accordance with the manufacturer's instructions and recommendations and protect from damage.

D. Cavity-Wall and Foundation Insulation:

Install polystyrene insulation board with globs of adhesive as recommended by manufacturer. Fit closely around reinforcing and obstructions, with all edges butted tightly.

Seal joints between insulation units by applying mastic to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation and around penetrations with mastic or approved sealant.

E. Loose CMU and Spray Foam Insulation: Install in strict accordance with the manufacturers' instructions.

3.03 INSTALLATION OF VAPOR RETARDER

A. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as approved by the Engineer. Extend vapor retarder to cover miscellaneous voids in insulation substrates.

B. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end and bottom edges, at perimeter of wall openings and at lap joints in a manner acceptable to the Resident; space fasteners 16 inches on center. After retarder has been fastened, cover fasteners and lap joint with approved tape.

3.04 PROTECTION

Protect installed insulation and vapor retarders from harmful weather exposures and from physical abuse. Installer shall advise Contractor of exposure hazards, including possible sources of deterioration and fire hazards.

END OF SECTION

SECTION 072600

VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6-mil- thick sheet, with maximum permeance rating of 0.1 perm.

B. ACCESSORIES

C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600

SECTION 074113.16

STANDING SEAM METAL ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The Contractor shall design, engineer and furnish all materials, equipment, supplies, tools, labor and supervision, and shall perform all work required for the complete installation of weathertight structural standing seam aluminum-zinc alloy coated steel roofing systems for the Building, complete with matching accessories and appurtenances as shown on the Contract Drawings, as specified herein, as required and recommended by the roofing system manufacturer and approved by the Engineer, and as is additionally required for the proper completion of the work, including but not limited: providing a continuous panel anchorage system, waterproofing membrane, expansion joint, crickets, edge treatments, trim closures, penetration flashing, base and cap flashings, transition flashings, miscellaneous flashings, fasteners, sealants, snow guards, etc.

Note: The Contract Drawings depict the design concept and the basic relationship of the various roofs to each other and to other surrounding construction. The metal roofing system shown on the Contract Drawings is a high profile, wide spaced batten system. However, the roof to be provided under this Contract shall be a structural standing seam metal roof as described hereinafter. Edge conditions, flashings, etc., shall remain as shown except where different details are proposed by the roofing system manufacturer to accommodate their particular roofing system and such changes are accepted by the Engineer.

It shall be understood that it is solely the Contractor's responsibility to fully inspect and investigate all conditions affecting the proper installation of the standing seam metal roofing system required, and to insure that all conditions are suitably provided for in the manufacture, fabrication and installation of the roofing system regardless of what may be shown/specified or not shown/specified on the Contract Drawings or in the specifications. The aesthetic requirements shown on the Contract Drawings, other than batten spacing, the requirements of these specifications, and the preferred recommendations of the roofing system manufacturer, as approved by the Resident, shall be complied with in all instances, at no additional cost to the Authority. In case of conflict between requirements, the more stringent and costly requirement, as determined solely by the Resident, shall apply. Therefore, it is incumbent on the Contractor to

review the Contract Work in detail with the proposed roofing system manufacturer(s) prior to submitting a bid for the Contract work.

Single panels with proper lap at intersections shall be use for each slope to cover the perimeter of the roof. Submit Shop Drawings for approval.

B. Flashing and sheet metal required for the work of this Section, such as for edge conditions and penetration flashings, shall match the roofing and shall be provided in accordance with the requirements of the roofing system manufacturer's approved Shop Drawings and installation instructions.

C. Joint sealer work that is required to make the roofing installation watertight and weathertight with abutting construction shall be performed as part of the work of this Section in accordance with the, roofing system manufacturer's approved Shop Drawings and installation instructions.

1.03 SUBMITTALS

A. Shop Drawings: As noted above, the Contract Drawings depict the design concept and the basic relationship of the various roofs to each other and to surrounding construction based on a high profile, wide spaced batten system. It is solely the responsibility of the Contractor to have the proposed roofing system manufacture develop detailed Shop Drawings to properly adapt the proposed roof system to all Project conditions. Shop Drawings shall include but not be limited to: layouts of vapor retarder, waterproofing membrane, and roofing panels, and full scale plans, elevations and details of edge conditions, joints, expansion joints, standing seam profiles, anchorages, blocking, flashings, closures, tie-ins to adjacent construction, and all other details required to fully illustrate all conditions of work. Distinguish between factory and field assembly work.

1. Shop Drawings shall bear the seal and signature of a Professional Engineer, licensed in the State of Maine.

2. Layout drawings and sections shall show adjacent construction, and be keyed into benchmarks and grid lines established on the Contract Drawings.

3. Details shall show dimensions, thicknesses, materials, finishes, continuous anchors, edge trim, sealant locations, fasteners and spacing, etc. Details shall also show and identify joint conditions, anticipated fabrication and erection tolerances, anticipated thermal movement, etc.

4. Provide isometric drawings for each juncture between flashing assemblies, at interfacing and adjacent work, at penetrations, and at typical roof transitions and end conditions.

5. Roofing panel, waterproofing membrane, vapor retarder, edge trim, etc., joints shall be laid out on the Shop Drawings. It shall be understood that the Engineer will be at liberty to revise joint layouts as deemed necessary, at no additional cost and with no time extension.

6. Submit erection drawings showing proposed sequence of installation.

7. Submit manufacturer's written instructions and comments, fastener descriptions and spacings, and all other pertinent information.

8. Submit manufacturer's written instructions and details for the snow guard system.

B. Product Data: Submit specifications for material and fabrication of metal roofing system materials, and detailed instructions and recommendations for handling, storing, installation and maintenance. Include manufacturers' product data for roof panels, fasteners, sealants, backer rod, insulation, vapor retarder, waterproofing membrane, and all other manufactured products. Include certified test reports showing compliance with requirements where a test method is indicated.

C. Samples

1. Submit samples of roofing system components. Provide assembled sample panels 18 inches long by two panels wide using the same materials to be used in the finished work. Include continuous anchors, fasteners, waterproofing membrane, insulation and other accessories. Provide a horizontal (end) joint on each side of standing seam in the middle of the sample panel.

2. Submit a 24 inch long radius roof edge fabrication (e.g., edge cover and brake metal closures), each with typical finished mating joints.

D. Quality Control/Assurance Submittals

1. Submit for review copies of ASCE-7 Load Analysis prepared and/or reviewed and sealed by a Professional Engineer licensed in the State of Maine.

2. Submit design calculations bearing the seal and signature of a Professional Engineer licensed in the State of Maine, indicating compliance with specified performance criteria and fastener pull-out calculations. The submittal shall indicate fastener types, spacings and numbers required for each installation condition.

3. Submit test reports for independent testing laboratories bearing the seal of a registered Professional Engineer to certify compliance with the specified performance criteria.

4. Submit complete and current data for the roof system as follows:

a. Thermal cycle testing of the metal roof panel and continuous panel anchors as specified.

b. Uniform ultimate wind uplift load capacity for the roofing system specified.

c. Ultimate pullout capacity for all anchors.

d. U.L. 90 classification data specific to the roofing system to be provided. Include letter by U.L. attesting that the roofing system is currently classified and listed.

e. Model load test per ASTM E 330, modified.

f. Static air infiltration test data.

g. Water penetration test data.

5. Submit manufacturer's complete log of field reports (initial, progress and final).

6. Upon completion of the work, submit letter from the manufacturer certifying that the roof installations are in accordance with the approved Shop Drawings and installation instructions and requirements, and that the manufacturer will issue the specified watertightness warranty.

E. Welding

Submit welder certifications.

F. Warranties

Submit samples of the roofing manufacturer's twenty-year warranty agreeing to repair/ replace defective materials and workmanship in an aesthetically acceptable manner, to the Authority's complete satisfaction, as required to maintain the roofing installations, including flashings, trim, etc., in a watertight condition under peak weather conditions. Warranty shall not exclude any conditions, such as flashings, trim, penetrations, etc.

Submit sample of the roofing manufacturer's standard twenty-year sheet steel warranty and material finish warranty.

Warranties shall be in addition to and not a limitation of other rights the Authority may have against the Contractor under the Contract Documents.

1.04 QUALITY ASSURANCE

A. Contractor shall have a minimum of 5 years continuous successful experience in fabricating and installing roofing systems of similar type (e.g., long field-formed panels) and complexity to that required for this Project and shall be an authorized installer for the roofing system manufacturer. Submit a list of installations. The manufacturer of the roofing system shall have a minimum of 10-years experience in the manufacturer of roofing systems of the type required for this Project.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Manufacturer's representative is to inspect and approve surfaces to which the roofing system material will be applied prior to start of work and shall instruct and assist installer as deemed necessary. Manufacturer's representative shall also provide intermittent project supervision and final inspection at end of work and before issuance of warranty. Also refer to paragraph 3.03.

D. In addition to complying with requirements of governmental agencies having jurisdiction, the roofing system shall comply with U.L. Class 90 wind uplift requirements based on wind loads at the site, U.L. Class A fire rating requirements and pertinent recommendations contained in the SMACNA "Architectural Sheet Metal Manual".

E. Roof System Requirements

1. Structural Tests: Installed roof system shall carry positive uniform design loads with maximum system deflection of L/180 as measured at the rib of the panel.

2. Water Penetration: Installed roof system shall exhibit no uncontrolled water penetration when exposed to dynamic rain at 6.25 psf differential air pressure for not less than five minutes, when testing in accordance with ASTM E 331.

3. The metal roof system shall be designed to:

   a. Drain leakage and condensation to the exterior.

   b. Provide independent movement of all roof components consistent with a thermal range of -20 to +180 degrees F, and consistent with anticipated movement of the building structures.

   c. Provide panel weathertightness without reliance on sealants or elastomeric membranes.

   d. Provide flashing, gutters, downspouts and edge assemblies related to the roof that are watertight.

   e. Provide required wind uplift resistance as determined by ASCE-7 analysis with a safety factor of 1.5.

F. Panel Anchor Requirements

Connection of continuous panel anchors to substrate shall be designed to resist loads developed by the specified pressures with due regard to prying forces and/or bending due to eccentric loading. Performances shall be evaluated at positions of extreme thermal movement. Factor of safety for connections shall be 2.5.

G. Uniform load capacity of 2 times design load shall be determined by testing in accordance with the principles of ASTM E 330, adapted to testing of formed sheet panels by additions to specific sections as follows:

1. Roof test specimens shall represent the conditions evaluated, free of undue influence of perimeter conditions. Panels shall be continuous over one or more interior supports and contain at least four panel widths.

2. No roof attachments are permitted at the sides other than the standard edge condition. For uplift tests, at least one end seal shall be flexible and in no way restrain the crosswise distortion of the panels.

3. Roofing panels and accessories are to be production material of the same type and thickness required for use on the Project.

4. Longitudinal seals or plastic film shall not span any crevice or crack that may tend to separate under differential pressure.

H. Any necessary welding shall be performed only by skilled workmen with current AWS certification for the type of welding work required for this Contract. Welding shall be performed in accordance with applicable AWS requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, and deterioration of the work. Form work to fit substrates. Comply with roofing system manufacturer's instructions and recommendations for forming material.

B. Materials shall be selected for their surface flatness and freedom from blemishes. Materials exhibiting waves, roller marks, gouges, dents, creases, pitting, scrapes, scars and similar defects will be rejected.

C. All metal work shall be formed to produce installed units free from waves, buckling, severe oil-canning and similar defects under all conditions of service. Units shall be formed true to line, with smooth "sharp" bend lines, and with exposed edges folded back to form hems.

2.02 ROOF SYSTEM MANUFACTURERS

A. The "Zee-Lock Roof System" produced by Berridge Manufacturing Company (as indicated in current literature) is cited as capable of meeting the appearance, quality, construction type, performance and durability requirements of this Contract. Systems by other manufacturers that are equivalent in all respects (i.e., appearance, type of

construction, performance and durability), may be used in the work. However, it shall be understood that the Resident will be the sole judge of a system's acceptability, and that the rejection of a proposed system shall not give rise to any claims for additional compensation or extension to the Time(s) of Completion.

2.03 METAL ROOF PANELS

A. Minimum 24 gage aluminum-zinc alloy (Galvalume) coated sheet steel conforming to ASTM A 792 in continuous field formed panels of the required lengths. The gage of the coated steel shall be increased from 24 gage, at no additional cost, if necessary to meet Contract requirements.

B. Panels shall have a minimum 2 inch vertical rib height, spaced 16 inches on center with smooth flat profile between standing seams.

C. Panels shall be true standing seam shape, requiring no foam closures or fillers at terminations.

D. Standing seams shall incorporate mechanically interlocked continuous anchors of a configuration that will prevent entrance or passage of water.

E. Continuous concealed anchors shall resist positive and negative loading yet permit thermal expansion and contraction of panels.

F. Seams that are not mechanically locked are not acceptable.

G. Standing seams shall contain a factory applied extruded vinyl weather seal to prevent siphoning of moisture through the side joint seam.

H. Horizontal seams shall not be permitted.

2.04 CONTINUOUS ANCHORS

A. Standing seam roof panels shall be fastened to continuous zee-shaped anchors that are secured to the substrate.

B. Manufacturer shall design the continuous anchors, fasteners and fastener spacing to maintain the required wind uplift resistance and other performance criteria.

2.05 MISCELLANEOUS METAL

A. Provide all necessary terminations, flashings, gutters, edge conditions, special shapes, transitions, expansion joints, etc., required for complete and weathertight installations. All such items shall be the same material as the roof panels, except that edge condition materials and brake metal closures shall be minimum 22 gage.

B. Fasteners

Exposed fasteners shall be Series 300 stainless steel fasteners with neoprene-backed watertight stainless steel washers. All exposed portions of fasteners and washers shall receive a two-coat high quality urethane finish to match the roof panels.

Exposed rivets, where approved by the Engineer, shall be self-plugging type, minimum 3/16 inch diameter, fabricated from Series 300 stainless steel with the same material for stems, and with neoprene seal washers.

Concealed fasteners shall be corrosion resistant type equal to self-drilling "Dril-lex" fasteners with "Stalgard" coating by Elco Industries, Inc., Rockford, IL.

Fasteners and plates for installation of insulation shall be equal to "Sarnafasteners and Plates" by Sarnafil, Inc., Canton, MA.

C. Plywood Sheathing

As specified in Rough Carpentry Section.

D. Roofing Underlayment

Self-adhering metal roofing underlayment shall be similar to Firestone “CLAD-GARD SA – N (North)” metal underlayment. Sheets shall be SBS rubber modified, self-adhesive asphalt blend with a woven slip-resistant traction film on the top surface and an opaque release film on the bottom surface.

G. Sealant

One-part silicone sealant equal to "Spectrem 1" by Tremco Sealants and Coatings, Beachwood, OH.

H. Fall Protection Roof Anchors: Provide fall protection roof anchors in locations indicated in the drawings. Provide Guardian CB-12 Roof Anchor or similar as approved by the Engineer.

2.06 FABRICATION

A. Fabricate panels onsite in continuous lengths as required. Examine panels as they are being formed to insure that they are within the manufacturer's acceptable tolerances.

B. Provide linear sheet metal items in minimum 10'-0" lengths except as otherwise approved on the Shop Drawings. Form flashing using single pieces for the full width. Provide shop fabricated, mitered and joint corners.

C. Comply with the dimensions, profiles, and details shown, or if not shown, in accordance with details provided by the Engineer.

2.07 SNOW GUARDS

A. Snow guards shall be prefabricated ladder type, aluminum two-pipe snow guards designed for use with standing seam metal roofing and complete with brackets and fasteners for anchoring as manufactured by Alpine Snow guards. Acceptable alternate bracket manufacturer shall be S-5! Metal Roof Innovations, Ltd. All snow guard components, including brackets and fasteners, shall match the color of the standing seam roof panels as selected by the Architect. No exceptions will be allowed.

2.08 GUTTERS AND DOWNSPOUTS

A. Gutters and downspouts shall be fabricated in sizes indicated. Gutters shall be seamless. Downspouts shall have sealed joints at bends, continuous seamless lengths at straight sections.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Inspection: Examine substrates to receive roofing. Do not proceed until all defects are corrected.

Verify that decks are sound, dry, and securely attached, and that provisions for flashings, expansion joints, and all items attaching or penetrating through the work of this Section have been provided for and that roofing work may proceed.

Field check dimensions and support alignment.

Provide all fastener alignment markings necessary so that marks can be transferred onto vapor retarder, as appropriate.

B. Sheathing: Installed as specified - Rough Carpentry Section.

C. Ice/Waterproofing Membrane: After the sheathing installation has been approved by the roofing system manufacturer's representative, apply ice/waterproofing membrane over sheathing in accordance with the approved Shop Drawings and the membrane manufacturer's installation instructions, taking care to provide 6 inch weatherlapped head joints and 18 inch lapped end joints in a manner to drain any entrapped moisture to the exterior.

D. Installation of Metal Roofing and Flashing

1. Install roofing in strict accordance with the approved Shop Drawings and installation instructions.

2. Metal workmanship shall conform to applicable standards set forth in the "Architectural Sheet Metal Manual" as published by SMACNA.

3. Isolate dissimilar metals and masonry or concrete from metals with an Engineer approved bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate and panels.

4. Limit exposed fasteners to extent indicated on Shop Drawings.

5. Anchorage shall allow for temperature expansion and contraction movement without stress or elongation of panels or fasteners. Attach continuous panel anchor to structural substrate using fasteners of size and spacing as determined by manufacturer's design analysis to resist specified uplift and thermal movement forces.

6. Coordinate flashing and sheet metal work to provide weathertight conditions at roof terminations. Fabricate and install in accordance with standards of SMACNA Manual using continuous cleats at all exposed edges.

7. Roofing, fascia overlay, gutter and accessories shall be installed in accordance with the approved Shop Drawings and installation instructions such that in plan and elevation, horizontal and vertical lines are true and square, and that other lines are as shown on the approved Shop Drawings. Provide adjustment within system to accommodate variations of existing structure. Deviation from designated locations shall not exceed 1/8 inch per 12 feet of length of any member or 1/4 inch in any total run in any line.

8. Verify with manufacturer locations of fixed connections and expansion connections.

9. Roll form panels on site taking care to properly support long panels (support at maximum 6 foot intervals).

10. Install starter and edge trim and fascia overlay before installing roof panels.

11. Install panels to continuous anchors (ribs) in accordance with the manufacturer's details.

12. Seam panel sidelaps using power-driven seamer as recommended by manufacturer to ensure watertightness.

13. Erect metal roofing with lines, planes, arrises and angles sharp and true, and plane surfaces free from waves, warp, dents, buckles, or other physical defects, with minimum oil canning.

14. Do not allow traffic on completed roof. If required, provided cushioned walk boards.

15. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.

16. Remove and replace any panels or components which are damaged beyond successful repair.

17. Fit components accurately together to form joints that will be weathertight.

18. Do not install components which are observed to be defective, including, but not limited to those that are warped, bowed, twisted, dented, abraded, or otherwise damaged, including damage to finish.

19. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in a visual imperfection or a failure in performance.

20. Do not allow panels to come into contact with dissimilar materials. Apply an Engineer approved isolator between surfaces. Use gasketed fasteners to eliminate the possibility of corrosive or electrolytic action between metals.

21. Coordinate the roofing work with that of other trades as necessary.

22. Thoroughly wipe-down roofing and other surfaces as erection progresses.

23. Install sealant as shown on the approved Shop Drawings and installation instructions.

F. Flashing

1. Comply with "SMACNA" Architectural Sheet Metal Manual" recommendations for installation of work.

2. Conceal fasteners and expansion provisions wherever possible.

3. Fold back edges of concealed side of exposed edge to form hem.

4. Insert metal flashings into reglets, anchor with fasteners and wedges and seal joints.

5. Set sheet metal items level, true to line, and plumb.

6. Secure to wood with screws.

7. Set metal already partly formed in place and fasten by means of cleats.

8. Use cleats to keep laps closed when face width exceeds 8 inches for 24 gauge steel.

G. Damaged Finishes: Repair damaged finish of panels, trim, closures, flashing, etc., to the satisfaction of the Engineer. If any item cannot be repaired to the Engineer's satisfaction, it shall be promptly replaced.

H. Snow Guards: Install as indicated on the Plans and as recommended by the manufacturer.

I. Fall Protection Roof Anchors: Install in accordance with the roof anchor manufacturer's written instructions and in accordance with the metal roofing manufacturer.

H. Gutters and Downspouts: Install in lengths and locations indicated using straps and hangers matching material and finish of gutters and downspouts.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

1. Manufacturer's representative shall be present at each pre-installation and pre-roofing conference, and during set-up of manufacturer's field forming equipment.

2. Manufacturer's representative shall examine the roof structures with installer prior to beginning roof installation.

3. Manufacturer's representative shall be present during initial layout and installation of roofing system. Observe minimum of initial one week period of roof panel installation on daily basis, ensuring installer follows manufacturer's installation recommendations and shop drawings. Observe initial forming passes for fabrication with acceptable tolerances.

4. Manufacturer's representative shall be on site for the duration of the installation period.

5. Manufacturer's representative shall examine completed installation for conformance to Shop Drawings. Notify installer and Contractor in writing of discrepancies.

3.04 CLEANING

A. Clean exposed surfaces of work promptly after completion of installation. To prevent rust staining on finished surfaces, immediately removing fillings produced by drilling or cutting.

B. Clean roof in accordance with manufacturer's recommendations.

C. Clean exposed surfaces of roofing and accessories after completion of installation. Leave in clean condition at date of Substantial Completion of Project. Touch up minor abrasions and scratches in finish.

D. Remove all scrap and construction debris from the site.

3.05 FINAL INSPECTION

A. Final inspection and certification will be provided by the manufacturer's representative.

3.06 PROTECTION AND CLEAN-UP

A. Leave all work clean, free from grease, finger marks, sealant stains, etc. Remove excess sealant, dirt and other substances from roofing system components and from abutting and surrounding construction. Cleaning materials and procedures shall be approved by the Engineer and be acceptable to the manufacturers of the materials to be cleaned. Advise the Contractor of protective measures and precautions required to ensure that roofing installations will be without damage or deterioration (other than normal weathering) at time of acceptance.

B. Remove all debris and rubbish caused by the work of this Section as the work progresses.

END OF SECTION

SECTION 075323

ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Substrate board.
3. Roof insulation.
4. Cover board.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Roof membrane and flashings of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
2. Warranty Period: 20 years from Date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and substrate boards for the following warranty period:

1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.

2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): -19.8 lbf/sq. ft.
2. Zone 2 (Roof Area Perimeter): -33.3 lbf/sq. ft.

a. Location: From roof edge to 3-ft inside roof edge.

3. Zone 3 (Roof Area Corners): -50.1 lbf/sq. ft.

a. Location: 3-ft in each direction from building corner.

D. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than when tested according to CRRC-1.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D 4637/D 4637M, Type II, scrim or fabric internally reinforced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products.
c. GenFlex Roofing Systems.

2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White on black.
4. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non- aromatic solvents, grease, and oil.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

F. Bonding Adhesive: Manufacturer's standard.

G. Seaming Material: Single-component, butyl splicing adhesive and splice cleaner or Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- wide minimum, butyl splice tape with release film.

H. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

I. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

J. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.

K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

L. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum board or ASTM C 1278/C 1278M, fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Georgia-Pacific Building Products.
c. National Gypsum Company.
d. United States Gypsum Company.

2. Thickness: 1/2 inch.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products.
c. GAF.
d. Insulfoam-a division of Carlisle Construction Materials Inc.
e. Johns Manville; a Berkshire Hathaway company.
f. Rmax, Inc.

2. Compressive Strength: 20 psi.
3. Size: 48 by 96 inches.
4. Thickness: Multiple layers (1-1/2" minimum) as required to meet minimum R- Value indicated.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch thick.

D. Cover Board: ASTM C 1177/C 1177M, glass-mat, ASTM C 1278/C 1278M, fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following similar to DensDeck:

a. CertainTeed Corporation.
b. Georgia-Pacific Building Products.
c. National Gypsum Company.

d. United States Gypsum Company.

2. Thickness: 5/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

        1) Trim insulation so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch with insulation.
    f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
        1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    f. Trim insulation so that water flow is unrestricted.
    g. Fill gaps exceeding 1/4 inch with insulation.
    h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    i. Loosely lay each layer of insulation units over substrate.
    j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
        1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

I. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

3. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
4. Apply lap sealant and seal exposed edges of roofing terminations.

J. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

K. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: _____.
7. Warranty Period: <Insert time>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding <Insert mph (m/s)>;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled

surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075323

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Contract Conditions and other Technical Specifications Sections apply to work of this Section insofar as applicable.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The work in this section consists of furnishing all materials, equipment, transportation, labor and supervision, and performing all operations required to provide all sheet metal work including crickets as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

1.03 SPECIFIED ELSEWHERE

A. Ductwork is specified under Division 23 – Heating, Ventilating and Air Conditioning.

1.04 GENERAL REQUIREMENTS

A. All sheet metal shall have the manufacturer's trade name and thickness or weight marked on each sheet.

B. Surface to which sheet metal is to be applied shall be even, smooth, sound, thoroughly clean, dry and free from all defects that might affect the installation. Materials furnished under this section which are to be built in by others shall be delivered to the site in time to avoid delays in construction progress. All cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed under this section. All accessories and other related items not specifically shown or specified also shall be provided under this section.

C. During construction, care shall be taken to prevent damage to roofing and flashing in place by not walking over or placing materials on or against them.

1.05 SUBMITTALS

A. Submit samples of all materials and copies of pertinent literature for approval before proceeding with the work.

B. Submit Shop Drawings detailing all flashing installations.

PART 2 - MATERIALS

2.01 MATERIALS

A. All copper shall be cold-rolled, 16 oz. lead-coated, as detailed or noted on the Drawings and specified herein.

B. Nails and other accessories used for fastening copper shall be copper, bronze or brass of the required sizes.

C. Solder shall be 40 percent pig lead and 60 percent block tin. Flux shall be muriatic acid killed with zinc, or an approved brand of soldering paste.

PART 3 - EXECUTION

3.01 INSTALLATION

All work shall be as shown on the Drawings, performed in strict compliance with the recommended practice and standard specifications of the Copper and Brass Research Association and "Copper and Common Sense" as published by Revere Copper and Brass.

END OF SECTION

SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in fire-resistance-rated horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

G. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.

2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

C. Penetration Firestopping Systems with No Penetrating Items: UL Classified System Group 0001-1000.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

D. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing: UL Classified System Group 1001-1999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

E. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing: UL Classified System Group 2001-2999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

F. Penetration Firestopping Systems for Electrical Cables: UL Classified System Group 3001-3999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

G. Penetration Firestopping Systems for Cable Trays with Electric Cables: UL Classified System Group 4001-4999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

H. Penetration Firestopping Systems for Insulated Pipes: UL Classified System Group 5001-5999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

I. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants: UL Classified System Group 6001-6999.

1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

J. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrants: UL Classified System Group 7001-7999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

K. Penetration Firestopping Systems for Groupings of Penetrants: UL Classified System Group 8001-8999.
1. F-Rating: 1 & 2 hour.
2. T-Rating: 1 & 2 hour.
3. W-Rating: No leakage of water at completion of water leakage testing.
4. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. In general, the conditions requiring joint sealers are shown on the Drawings. This phase of work includes the furnishing all equipment, labor and materials necessary to provide joint sealant installations which are complete in every respect and of the composition and quality as specified herein.

B. The required applications include, but are not necessarily limited to the following:

1. Pavement and sidewalk joints subjected to foot or vehicular traffic.

2. Exterior building wall joints, including joints at windows, doors and louvers.

3. Flashing and coping joints.

4. Miscellaneous concrete construction joints.

5. Partition, ceiling, and door frame joints.

6. Masonry expansion joints; exterior and interior.

7. Construction joints in islands, curbing, pavement and barrier walls.

8. Plumbing fixtures,

C. Sealants for glazing are specified in Section 088000.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturers' specifications, recommendations and installation instructions for each type of material and application

required. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.

B. Samples: Submit three 12-inch-long samples of each color required for each type of joint sealer exposed to view. Install sample between 2 strips of material similar to or representative of typical surfaces where sealer will be used, held apart to represent typical joint widths. Samples will be reviewed by the Engineer for color and texture only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

C. Guarantee: Submit two copies of written guarantee agreeing to repair or replace joint sealers which fail to perform as airtight and watertight, or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability, or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The Contractor shall provide signed guarantee for a period of two years.

1.04 QUALITY ASSURANCE AND COORDINATION

A. Prior to commencing work required by this Section, the Contractor shall examine the areas and conditions which exist where joint sealer work is to be performed and notify the Engineer in writing of any conditions which are in conflict with requirements of the Contract Documents and are detrimental to the proper and timely completion of the Work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above the manufacturer's recommended limitations for installation. Proceed with the work only when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

PART 2 - MATERIALS

2.01 MATERIALS

A. Colors: For exposed materials provide color as indicated or, if not indicated, as selected by Engineer from manufacturer's standard colors. For concealed materials, provide the color which has the best overall performance characteristics.

B. Hardness: As recommended by manufacturer for application shown, unless otherwise indicated or required by the Engineer.

C. Modulus of Elasticity: Provide the lowest available modulus of elasticity which is consistent with exposure to weathering, indentation, vandalism, abrasion, support of loading, and other requirements.

D. Compatibility: Before purchase of each required material, confirm its compatibility with each material it will be exposed to in the joint system. Notify the Resident of potential problems.

E. Size and Shape: As shown or, if not shown, as recommended by the manufacturer and approved by the Resident for the type and condition of joint, and for the indicated joint performance or movement.

F. Grade of Sealant: For each application, provide the grade of sealant (non-sag, self-leveling, no-track, knife grade, preformed, etc.) as recommended by the manufacturer and approved by the Resident for the particular condition of installation (location, joint shape, ambient temperature, and similar conditions), to achieve the best possible appearance and overall performance. Grades specified herein are for normal conditions of installation.

2.02 ELASTOMERIC SEALANTS

A. Foot Traffic Joints: Two-component polyurethane sealant; polyurethane- based, 2-part elastomeric sealant, complying with FS TT-S00227E, Type 1, Self-leveling, Class A. Provide one of the following:

Pecora NR-200; Pecora
SL-1 Sonolastic Pavement Joint Sealant; Sonneborn/Contech, Inc.
Tremco THC - 900/901; Tremco

B. Exterior Joints and Interior Moving Joints: Polymeric base sealant; modified polyurethane rubber, 2 or 3-part elastomeric sealant complying with FS TT-S00227E, Type II, Non-sag, Class A. Provide one of the following:

Dymeric Sealant; Tremco
Dynatrol II; Pecora
Sonolastic NP-2; Sonneborn/Contech Inc.

Note: Wherever polyurethane sealants are in contact with anodized aluminum, the sealant manufacturer's recommended primer shall be used.

2.03 NON-ELASTOMERIC SEALANTS

Interior Non-moving and Non-watertight Joints: One-component, non-staining, non-sagging, non-bleeding acrylic emulsion base latex sealant. Use only at interior joints where movement is not likely and watertightness is not necessary. Sealant shall be "Mono" by Tremco or approved equal by Pecora or Sika.

Interior Non-Moving Watertight Joints: One-component non-sag wet-curing mildew-resistant silicone sealant for use at waterproof joints around plumbing fixtures and wet environment assemblies.

Spectrum 1: Tremco
Pecora 898NST: Pecora

2.04 JOINT FILLERS

A. Bituminous and Fiber Joint Filler:

B. Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D 1751, FS HH-F-341, Type 1 and AASHTO M 213. Provide where concrete slabs meet walls and similar isolation points as shown on the Drawings or directed by the Engineer.

C. Joint Primer/Sealer: Provide the type of joint primer/sealer recommended by the sealant manufacturer for the joint surfaces to be primed or sealed.

D. Bond Breaker Tape: Self-adhering polyethylene tape or other plastic tape as recommended by the sealant manufacturer to be applied to surfaces where bond of sealant to the substrate or joint filler or backer rod must be avoided for proper performance of sealant.

E. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, closed-cell, non-absorptive, non-gassing material as recommended for compatibility with sealant by the sealant manufacturer and approved by the Engineer. Install backer rod behind the sealant in all exterior and interior masonry expansion joints unless otherwise detailed.

F. Compressible Filler and Fire-rated Sealant: Filler shall be "Polytite" precompressed expanding tape as manufactured by Sandell Mfg. Co. or approved equal by W. R. Grace or Willseal. Sealant shall be approved gun-grade material by 3M Co. or Hilti.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

3.02 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous or glazed joint surfaces if recommended by sealant manufacturer.

B. Prime joint surfaces wherever shown or recommended by the sealant manufacturer. Do not allow primer to spill or migrate onto adjoining surfaces.

C. At exterior masonry joints where flexible thru-wall flashing has been left extended 4 inches beyond the wall, carefully secure the flashing to the upper masonry wall in order to prepare the joint to receive sealant.

3.03 INSTALLATION

A. Set joint filler units at proper depth and position in the joint to coordinate with other work, including the installation of bond breakers and backer rods. Do not leave voids or gaps between the ends of joint filler units; bond ends together as recommended by the manufacturer.

B. Install sealant backer rod for elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

C. Take care to ensure that sealant does not cover any weep holes.

D. After the joints where the flexible thru-wall flashing occurs have been sealed and the sealant has cured sufficiently to prevent deformation of the joint, carefully cut off the extended thru-wall flashing to protrude 1/8 inch beyond the end of the horizontal leg of any exposed steel lintel at a window or door opening.

E. Install bond breaker tape wherever shown and required by the manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

F. Employ only proven installation techniques which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, and with complete "wetting" of the joint bond surfaces on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining

surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

G. Install sealant to depths as shown or, if not shown, as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead.

For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other types of abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 3/4-inch-deep nor less than 3/8 inch deep.

For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2-inch-deep nor less than 1/4 inch deep.

For joints sealed with non-elastomeric sealants fill joints to a depth in the range of 75% to 125% of joint width.

H. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces or glass, or to migrate into the voids of adjoining surfaces. Clean such surfaces by whatever means may be necessary to eliminate evidence of spillage, as approved by the Engineer.

I. Recess exposed edges of gaskets and joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from the joint.

J. Bond ends of gaskets together with adhesive or by other means as recommended by the manufacturer to ensure continuous watertight and airtight performance. Miter-cut and bond ends at corners unless molded corner units are provided.

3.04 CURING AND PROTECTION

Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability. Advise the Contractor of procedures required for the cure and protection of joint sealers during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of Authority's acceptance.

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. Standard steel doors and frames (including transoms and louver frames) are indicated on the Drawings and details, and are itemized in the Door Schedule. The work includes furnishing all materials, equipment, labor and supervision, and performing all operations necessary to furnish and install steel doors and frames complete in every respect, as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

B. The application of finish hardware for steel doors is part of the work of this section but hardware is provided under Section 087100.

C. Furnishing and installing steel frames for louvers is part of the work of this section. Furnishing and installing louvers is specified under Section 101010.

D. Glass and glazing will be performed under Section 088000.

1.03 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and complying with these specifications. Doors shall be Grade II, Heavy Duty, Model 1, galvanized at exterior locations; face sheets for exterior doors shall be 16 gage, face sheets for interior doors shall be 18 gage. If a conflict should exist between the standard and the specifications, the more stringent or conservative requirement shall apply.

B.

1.04 SUBMITTALS

A. Product Data: Submit for the Engineer's approval, eight (8) copies of manufacturer's specifications for fabrication and installation, including data substantiating that products comply with specified codes and requirements. Also provide technical data for prime paint material and application.

B. Shop Drawings: Submit for the Engineer's approval, one transparency and three prints of drawings to be used for the fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints, connections, anchorages and accessory items.

C. Provide a schedule of doors and frames using same reference numbers for details and openings as those on the Contract Drawings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials cartoned or crated to provide protection during transit and jobsite storage.

B. Inspect materials upon delivery for damage. Minor damage may be repaired provided finished items are equal in all respects to new work and acceptable to the Engineer, otherwise, remove and replace damaged items at no additional cost.

C. Store doors and frames at the site under cover in accordance with the manufacturer's recommendations. Place units on wood dunnage at least 4 inches high, or otherwise store on floors in manner that will prevent rust and damage. Avoid use of non-vented plastic or canvas shelters which could create humidity chambers. If cartons become wet, remove them immediately. Provide 1/4 inch to 1/2 inch space between stacked doors and frames to promote air circulation.

PART 2 – MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

Provide steel doors and frames by Steelcraft, Republic, or Curries.

2.02 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 568 and ASTM A 569.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526 having ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors:

1. Furnish wall anchors as required to secure frames to adjacent construction, formed of not less than 18 gage galvanized steel sheet (before galvanizing), as follows:

a. Concrete Masonry Unit Construction: Adjustable, T-shape flat, corrugated or perforated, to suit frame size with leg not less than 3 inches wide by 10 inches long. Furnish at least 4 anchors per jamb.

b. Floor Anchors: Provide floor anchors for each jamb and for mullions which extend to the floor, formed of not less than 0.0625 inch thick (No. 16 gage) galvanized steel sheet, as follows:

- Monolithic Concrete Slabs: Clip type anchors, with 2 holes to receive fasteners, welded to bottom of jamb and mullions.

- Head Anchors: Provide 2 anchors at head of frames exceeding 36 inch wide.

2. Spreader Bars: Provide 2 removable spreader bars across the bottom of frames, tack welded to jambs and mullions.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D, as applicable. Expansion anchors shall be "Kwik-Bolts" as manufactured by Hilti Fastening Systems or approved equal.

F. Shop-Applied Paint: High quality rust-inhibitive baked-on enamel suitable as a base for specified finish paints.

2.03 FABRICATION

A. Fabricate steel door and frame units (including transoms), to be rigid, neat in appearance, and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify and match-mark work that cannot be permanently factory-assembled before shipment to assure proper assembly at the site.

B. Fabricate exposed faces of doors, and frames for exterior door and louver units from cold-rolled steel only.

C. Fabricate frames for interior doors, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel at manufacturer's option.

D. Doors prepared for glass lights shall have the openings securely framed and shall be complete with screwless snap-in glazing beads on the non-security side.

E. Finish Hardware Preparation:

Prepare doors and frames to receive mortised and concealed finish hardware in accordance with the approved Finish Hardware Schedule and templates provided by hardware manufacturer. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware. Where surface mounted hardware is to be applied, frames shall have reinforcing plates.

Minimum thickness of hardware reinforcing plates shall be as follows:

Hinge reinforcements - 7 gage 1-1/4" x 10" minimum size.

Strike reinforcements - 12 gage.

Flush bolt reinforcements - 12 gage.

Closer reinforcements - 12 gage.

Reinforcements for surface-mounted hardware - 12 gage.

Locate knobs, levers, panic devices, push plates, and pulls in accordance with the requirements of ANSI A117.1-86, "Specifications for Making Buildings and Facilities Accessible to and Usable by, Physically Handicapped People" and ADA Guidelines. Locate other finish hardware items in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.

F. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.

G. Plaster Guards: Provide 26 gage (minimum) steel plaster guards or mortar boxes, welded to frame at back of finish hardware cutouts where mortar or other materials might obstruct hardware installation or operation.

H. Shop Painting:

Clean, treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.

Apply shop coat of prime paint of even consistency and bake to provide a uniformly finished surface ready to receive finish paint.

2.04 STANDARD STEEL DOORS

A. Provide metal doors of the types and styles indicated on the Drawings or Schedules and complying with SDI SD 100, Grade II, Heavy Duty, Model 1, galvanized for exterior locations. Doors shall be made of commercial quality, level cold-rolled steel and free of scale, pitting or other surface defects. Face sheets for interior doors shall be not less than 18 gage. Face sheets for exterior doors shall be not less than 16 gage and shall be hot dip galvanized.

B. Flush Door Construction:

All doors shall be of the types and nominal sizes shown on the Door Schedule and approved shop drawings. Minimum door thickness shall be 1-3/4 inches.

All doors shall be strong, rigid and neat in appearance, free from warpage and buckle. Corner bends shall be true, straight and of the minimum radius for the gage of metal used.

Doors shall be reinforced, stiffened and sound deadened with impregnated kraft honeycomb core (or approved closed-cell insulation at exterior locations), completely filling the inside of the door and laminated to the inside faces of panels. Other core construction, standard with approved manufacturer's meeting specified U.L. Label requirements and providing effective sound deadening, are acceptable.

Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than 16 gage extending the full width of the door and spot welded to both faces (hot-dip galvanized for exterior doors). Exterior doors shall have an additional flush closing hot-dip galvanized channel at their top and bottom edges with suitable openings be provided in the bottom closure to permit the escape of entrapped moisture.

Beveled edge profiles shall be provided on both vertical edges of doors.

C. Door Louvers:

Provide sightproof stationary louvers for interior doors where indicated, constructed of inverted V-shaped or Y-shaped blades formed of 24 gage cold-rolled steel set into 20 gage steel frames.

2.05 STANDARD STEEL FRAMES

Provide metal frames for doors and transoms, including frames for wood doors, of types and styles as shown on Drawings and schedules butted and wrap-around), utilizing concealed fastenings, unless otherwise indicated.

Frames for exterior openings and interior U.L. labeled doors shall be made of commercial grade cold-rolled steel, not less than 14 gage. Exterior frames shall be hot dip galvanized steel. Frames shall be designed for a minimum 25 pounds per square foot horizontal load.

Frames for other interior openings shall be either commercial grade cold-rolled steel or commercial grade hot-rolled and pickled steel. Metal thickness for frames shall be not less than 16 gage.

Frames for exterior doors, interior masonry walls and drywall openings shall be press brake formed with 5/8" high integral stops. Corners shall be back seam and face welded with face welds ground neatly smooth.

Fabricate frames of full welded unit construction, with corners mitered, reinforced, continuously welded the full depth and width of frame, with welds dressed smooth and flush. Knock-down type frames are not acceptable. Frames shall be manufactured by the same manufacturer who is supplying the hollow metal doors.

PART 3 - EXECUTION

3.01 INSPECTION

Examine substrate and conditions under which steel doors and frames are to be installed and notify the Engineer in writing of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 INSTALLATION

A. Install hollow metal units and accessories in accordance with final shop drawings, the manufacturer's approved installation instructions, and as specified herein.

B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

Place frames prior to construction of enclosing walls and ceilings. Protect hardware securements from mortar spillage, joint compound, and other damage. Set frames accurately in position, plumbed, aligned, and securely braced until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Door frame installation also includes setting of thresholds where applicable.

In masonry construction, locate 4 wall anchors per jamb. Building-in of anchors and grouting of frames is specified in Division 4.

Install fire-rated frames in accordance with NFPA Pamphlet No. 80.

C. Finish Hardware:

Install finish hardware in strict accordance with the final approved shop drawings and the manufacturers' instructions, and adjust for easy action. Set locksets level and true

with the proper backset. Adjust striking plates to be in exact alignment with bolts and latches. Adjust spindles and latch bolts for easy action. Set all screws flush with the metal surface without any broken or damaged heads.

All wrapping on knobs, handles, pulls, etc., furnished by the manufacturer shall be replaced on the hardware after it is installed and shall remain until final acceptance of the work, at which time the Contractor shall remove and dispose of all coverings.

D. Door Installation:

Hang doors plumb and true with a uniform clearance at the head and jambs, in accordance with SDI-100 and NFPA Pamphlet 80, and with all hardware in perfect working order.

3.03 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth rusted and damaged areas of prime coat and touch-up with compatible air-drying primer.

B. Final Adjustments: Check and re-adjust operating finish hardware items leaving steel doors and frames undamaged and in complete and proper operating condition. Remove and replace defective work.

END OF SECTION

SECTION 084113

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, transportation, labor and supervision, and performing all operations required to furnish and install an aluminum entrance door, frame, transom, sidelite, associated hardware, and joint sealing as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

1.03 SPECIFIED ELSEWHERE

A. Joint sealing related to aluminum frames is part of the work of this section and shall be performed in accordance with the requirements of Section 079200, Joint Sealers.

B. Glass and glazing shall be performed under Section 088000.

1.04 GENERAL REQUIREMENTS

A. Aluminum entrance door, frame and transom, as detailed on the Drawings and specified herein are as manufactured by Kawneer Architectural Products. Products of similar quality and appearance manufactured by Vistawall or Wausau will be considered for use. The door detailed is a Wide Stile Kawneer "350 Entrance Door" with "451T" framing.

B. Performance: The design and construction of the aluminum entrance doors shall be such as to pass the tests listed below.

1. Dual Moment Load Test as follows:

a. Test sections shall consist of a standard top door corner assembly. Side rail section shall be 24 inch long and top rail section shall be 12 inch long.

b. Anchor "top rail" positively to test bench so that corner protrudes 3 inches beyond bench edge.

c. Anchor a lever arm (capable of supporting 300 pounds) positively to "side rail" at a point 19 inches from inside edge of "top rail". Attach weight support pad at a point 19 inches from inner edge of "side rail".

d. Test section shall withstand a load of 270 pounds on the lever arm before reaching the point of failure which shall be considered a rotation of the lever arm in excess of 45°.

1.05 SHOP DRAWINGS AND PRODUCT DATA

Submit eight (8) copies of shop drawings showing door and frame details for approval. Submit seven copies of manufacturers' product data for door, framing, and each type of hardware required.

1.06 SAMPLES

A. Submit two (2) sets of 12 inch long samples of extrusions and formed shapes. Include 3 or more samples in each set showing near-limits of variations in color and finish. Once approved, samples submitted under this section will establish the extreme variation in color acceptable.

B. Submit samples of each type of hardware required.

PART 2 - MATERIALS

2.01 MATERIALS

A. Sections shall be extruded from 6063-T3 aluminum alloy (ASTM B 221, alloy GS 10A-T5).

B. Major portions of the door stiles shall be .125 inch in thickness; glazing molding shall be .050 inch thick.

2.02 CONSTRUCTION

A. Doors. - The Kawneer "350 Entrance Door" shall have vertical stiles of 5 inches, top rails of 5 inches, and bottom rails of 6-1/2 inches. Corner construction shall consist of both SIGMA deep penetration welds and mechanical clip fastening. Glazing stops shall be of the snap-in type with neoprene bulb-type glazing for 1 inch insulated glass units, located on the non-security side of the door. No exposed screws shall be required to secure stops. Stops on exterior side shall be lock-in tamper proof type.

B. Framing. - The Kawneer "451T" framing system shall provide for flush glazing on all sides with no projecting stops. Vertical and horizontal members shall have a nominal face dimension of 2 inches, a nominal depth of 4 1/2 inches, and shall provide for 1 inch insulated glass units. All entrance framing members shall be weatherstripped.

C. Weather-stripping: Provide Kawneer "Sealair" weather-stripping system in the doors and frames consisting of a dense, semi-rigid polymeric material which remains resilient and retains its weathering ability through temperature extremes. The system shall be provided with an EPDM blade gasket sweep strip attached to the door bottom with concealed fasteners. Weather-stripping and sweep shall be compatible with the threshold provided.

2.03 FINISH

All exposed members shall be free of scratches and other surface blemishes. All aluminum shall have fluoropolymer paint coating conforming to requirements of AAMA 605.2-92. Custom color will be selected.

2.04 HARDWARE

A. Hardware for aluminum entrance doors (including the interior vestibule doors) shall be furnished and installed by the door manufacturer except otherwise noted, and shall include the following hardware items by the manufacturers specified or approved equal.

1. Hinges shall be full-mortised butts, 3 per leaf, heavy duty.

2. Rim Exit Device shall be Von Duprin CD 98 x less pull x US 32D with cylinder and interchangeable core provided under Section 08700.

3. LCN Cush-N-Stop surface closer with adjustable hold open feature or approved equal by Russwin or Sargent.

4. Pull shall be Rockwood No. 158 x US 32D or approved equal by Brookline or Ives.

5. Aluminum threshold shall be supplied and installed under Section 087100.

B. Anchors and Fastenings: Furnish and install all bolts, nuts, anchors, sleeves and clips necessary for proper anchorage and support of aluminum work. All fastening devices shall be aluminum or non-magnetic stainless steel. Expansion bolts shall be stainless steel "Kwik-Bolts" as manufactured by Hilti Fastening Systems or approved equal.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum units where feasible, otherwise nonmagnetic stainless steel; except, at fabricator's option, brackets not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A 386. Provide nonstaining, nonferrous shims for installation and alignment of metal work.

D. Concealed Flashing: Non-magnetic stainless steel, 26 gage, type selected by manufacturer for compatibility.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

Furnish inserts at proper times for setting in concrete formwork, masonry, and similar construction indicated to support work of this Section.

3.02 INSTALLATION/ERECTION

A. General: Comply with manufacturer's instructions for protection, handling and installation of the door, fabricated components, and hardware with particular attention and care to the preservation of applied finishes and to provide a weathertight installation. Discard and/or remove and replace damaged members immediately upon discovery.

B. Framing Erection: Install components plumb, level, accurately aligned and accurately located. Anchor components securely in place in the manner indicated on the approved shop drawings, shimming and allowing for required movement, and providing separators and insulators to prevent corrosion and electrolytic deterioration, and to prevent "freeze-up" of moving joints.

C. Installation of Door and Finish Hardware:

1. Make sure that the door, frame and transom are properly installed with square corners, plumb sides, level at the head, securely attached to surrounding construction and of the size and hand shown on the Drawings. Do not install the door in an improperly installed frame.

2. Door openings shall not have more than the clearance specified by the manufacturer at sides, top, and bottom.

3. Apply finish hardware in strict accordance with the final approved shop drawings and the manufacturers' instructions. Use care not to damage adjacent surfaces when installing hardware. Adjust door to be in exact alignment and hardware for easy action. Set all screws flush with the metal surface without any broken or damaged heads.

D. Dissimilar Contact Surfaces:

1. Metals - Where aluminum is placed in contact with any metal other than non-magnetic stainless steel, the aluminum contact surface shall be given a heavy brush coating of zinc chromate primer made with a synthetic resin vehicle followed by two coats of an aluminum metal paint or shall be separated with an approved non-absorptive tape or gasket.

2. Masonry - Aluminum placed in contact with masonry, mortar or concrete shall be given a heavy brush coating of an approved alkali-resistant, non-migrating, bituminous paint.

E. Sealants and Joint Fillers: Furnish and install in accordance with Section 079200, Joint Sealants.

F. Glazing: Provided under Section 088000, Glazing.

3.03 ADJUST AND CLEAN

A. Just prior to the completion of all work under this section, the Contractor, with the Engineer, shall inspect all portions of the work, and shall make all required adjustments and corrections to the work, leaving all operable portions in proper operating condition and insuring that all jointing is tight. In addition, each piece of finish hardware shall be inspected to see that it is undamaged and in perfect working order.

B. Clean completed work, inside and out, promptly after erection to the Engineer's satisfaction. Remove dirt and other substances from aluminum and other affected surfaces.

C. Remove protective coating (if any) when completion of construction activities no longer requires its retention. Removal shall be in accordance with manufacturer's instructions.

D. Perform minor touch-up work to members with finish damage to the Engineer's satisfaction. Should the Engineer, as sole judge of acceptability of repairs, deem a repair as unsatisfactory, the Contractor shall promptly remove and replace such damaged members at no additional cost.

E. Institute protective measures and other precautions required to assure that all metal work and doors will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 085113

ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The work in this section consists of furnishing all materials, equipment, supplies, transportation, labor and supervision, and performing all operations required to furnish and install, weathertight, all aluminum windows, including insulating glass, as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

B. Related sealant and glass and glazing work are included as part of the work of this section and shall be provided in accordance with the requirements of Sections 07900 and 08800, respectively.

1.03 GENERAL

A. The Contractor shall verify all measurements at the building site and shall be responsible for dimensions, fitting, and the proper attachment of items related to the aluminum windows. Windows shall be fixed type. Window units shall be factory fabricated insofar as possible, consisting of, as applicable, frame, sash, sills, panning, mullions, insulating glass, sealants and anchors.

B. Storage and Protection: Materials shall be stored out of contact with the ground and under a weathertight covering. Storage shall be arranged to avoid bending, warping, or otherwise damaging the materials and to provide adequate ventilation.

C. Window frames, mullions, panning, screens, etc., shown on the Drawings are Kawneer 451T framing system as manufactured by Kawneer Co., Inc. Similar thermal-break windows by other reputable manufacturers will be considered provided they meet or exceed the requirements of the Kawneer windows specified. The Contractor shall obtain preliminary approval of the manufacturer's stock details from the Resident before complete shop drawings are prepared. Final approval will be based upon complete shop drawings showing all features of window fabrication and conditions of installation as detailed on the Drawings. All detailed requirements must be met.

D. Performance Requirements: Windows shall exceed the current specifications of the Architectural Aluminum Manufacturers Association (AAMA) and shall bear the Quality Certified Seal of AAMA for PA3-A3HP.

1.04 SUBMITTALS

A. Submit eight (8) copies of product data for all materials and shop drawings to the Engineer for approval. Shop drawings shall indicate the location and elevation of each type of window and shall show type and location of hardware, weather-stripping, locations of sealants, details of construction, including insulated glass/aluminum spandrel panels, glazing, anchorages, methods of assembly, and installation of all components.

B. Submit two (2) sets of 12 inch long samples of extrusions and formed shapes. Include 3 or more samples in each set showing near-limits of variations in color and finish. Once approved, samples will establish the extreme variation in color acceptable.

C. Submit samples of each type of hardware required.

PART 2 – MATERIALS

2.01 GENERAL

2. Frames unless otherwise noted shall be fabricated from extruded aluminum sections incorporating a continuous rigid polyurethane thermal barrier (break). Members shall not be less than 4-1/2 inches deep from front to back. Face dimensions of frames shall be approximately 2 inches; webs and flanges shall be not less than .090 inch thick.

B. Glass: Shall be 1” insulating units as specified in Section 088000, Glazing.

C. Sealants: Shall be as specified in Section 079200, Joint Sealants.

2.02 CONSTRUCTION

2. Fabricate aluminum windows in accordance with the approved shop drawings.

B. All joints in aluminum framing shall be hairline and mechanically fastened.

C. The back wall of the polyurethane pocket shall be removed to form a thermal barrier system. There shall be no frame members, corner construction or hardware application that bridges or violates the thermal barrier in any way.

D. Special acrylic or butyl small-joint sealer shall be applied at all intersections to provide permanent watertight joints. Sections shall be designed to provide a flush condition of frame and vent members on the exterior and to position all glass in the same vertical plane.

2.03 GLAZING

Windows shall be arranged for inside glazing with aluminum extruded snap-in glazing beads designed to accommodate 1 inch insulating glass units and 1 inch insulated spandrel panels. Snap-in glazing beads shall securely interlock into the extruded window sections without extending underneath the glass or spandrel panel, or bridging the thermal barrier. Glazing rabbet legs shall be a minimum of ¾ inches in height.

2.04 FINISH

All exposed aluminum for windows, sills, panning, and flashing shall have a fluoropolymer paint coating conforming to requirements of AAMA 605.2-92. Custom color will be selected to match aluminum storefront framing and door specified in Section 08400.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Windows shall be installed in strict accordance with the approved shop drawings and the manufacturer's approved installation instructions, without forcing or distortion so that sills and heads are level and jambs are plumb. Window frames shall be securely anchored in place with heavy gauge anchors, four (4) per jamb.

B. Glass units shall be furnished, installed and cleaned in accordance with the applicable requirements of Section 088000, Glazing.

C. Sealants shall be furnished and installed in accordance with the requirements of Section 079200, Joint Sealants.

3.02 ADJUSTMENT AND CLEANING

A. After installation, glass and metal surfaces shall be cleaned and any staining or discoloring of the finish shall be restored to the Engineer's satisfaction or the unit shall be replaced at no additional cost. All other work detrimentally affected by the installation of the windows shall also be cleaned or otherwise restored to the Resident's satisfaction.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all labor, materials, equipment and transportation and performing all operations required to furnish all finish hardware as shown on the drawings and specified herein.

1.03 SPECIFIED ELSEWHERE

A. The following related work items shall be furnished and installed under other sections of these specifications as indicated.

1. Hardware for Aluminum Entrance Door - Section 084113.

2. Hardware for Cabinets - Section 062013.

1.04 GENERAL

A. No finish hardware shall be delivered until all operations causing dampness have been completed. Care shall be taken to protect hardware from scratching and foreign matter, such as paint, joint compound, etc.

B. All items of hardware shall be packed in approved manufacturers' containers with all trimmings, bolts, screws, etc., as required. Each container shall be accurately labeled and marked with an item location corresponding to the number listed on the approved Finish Hardware Schedule.

C. Strikes for locks shall be box type with sufficient lip protection to protect frames and trim.

D. All locks shall be construction master keyed. Four (4) construction master keys shall be furnished. All locks shall be set to new building master keys as directed by the Resident. Furnish six (6) master keys and two keys for each lock.

E. Where size or shape of members is such as to prevent the use of the types specified, hardware shall be furnished of suitable type having as near as practicable the same operation and quality as the specified type; sized to be adequate for the required service, and approved by the Engineer.

1.05 SUBMITTALS

As part of the submission of shop drawings, the Contractor shall submit to the Engineer for review eight (8) copies of the schedule of finish hardware to be provided, giving manufacturers' names, catalog number references, type numbers, finish, and location of each item of hardware (identified with the door for which it is intended), and also the catalog cuts for each hardware item.

PART 2 - MATERIALS

2.01 MATERIALS

A. All finish hardware shall be of the best grade of solid metal, entirely free from imperfections in manufacture and finish. Finish shall be US 26D Satin Chromium Plated and US 32D Satin Stainless Steel, as applicable. Door closer units shall have sprayed lacquer finish to match balance of hardware.

B. The following items and manufacturers thereof indicate the quality and design of the hardware required.

1. Hinges: All door butts shall be Stanley No. FBB199 (US 32D), shall conform to ANSI A156.1 (A2111). Equivalent hinges manufactured by Hager Hinge Co. are also acceptable.

2. Locksets shall Best Lock 35H x 16H x L x US 32D with anti-friction latch bolts and interchangeable cores. Function will be determined at time of hardware submittal by the Resident at no additional cost.

3. Door Closers shall be LCN Smoothee Series with parallel arm "Cush-N-Stop" for push side and LCN's heaviest duty arm for pull side. Comparable closers manufactured by Sargent and Russwin will be considered for use. Provide coordinator at pairs of doors with adjustable safety release and internal override.

4. Silencers shall be manufactured by Pemko, Sargent & Co. or Glynn-Johnson.

5. Thresholds shall be of a style approved by the Resident, manufactured by Reese, National Guard or Pemko. All exterior doors shall have an extruded aluminum threshold with an integral slip-resistant surface set in sealant to provide watertight condition. Thresholds shall be secured to floor construction with suitable stainless steel flat head screws in expansion shields. Slip-resistant coating shall be equal to "PemKote" by Pemko. If size is not shown, provided threshold width equal to jamb depth.

Threshold - Type A:	Pemko 171A w/PemKote
Threshold - Type B:	Pemko 270A and 282A, each with 1/4" high w/PemKote.

6. Kick plates and mop plates shall be 22 gage stainless steel, 8" high by width of door less 2", attached with stainless steel screws, as manufactured by Brookline, Ives or Rockwood.

7. Weather-stripping Systems shall be provided at all exterior doors and frames consisting of a dense, semi-rigid polymeric material which remains resilient and retains its weathering ability through temperature extremes. Weather-stripping and sweep shall be compatible with the threshold provided. Weather-stripping shall be of a style approved by the Resident, manufactured by Reese, National Guard or Pemko.

Door Shoe:	Pemko 234AV (cold weather seal)
Jamb & Head:	Pemko 319CR

8. Floor Stops, and Wall Stops shall be manufactured by H.B. Ives Co., Brookline Industries Inc., Stanley, or Glynn-Johnson.

9. Exit Device and Pull: Refer to Section 08400.

10. Electric Strike: Provide Galaxy Model 1006-12/24D-630 X KM-630.

2.02 FINISH HARDWARE SCHEDULE – US26D

SET NO. 1

Single Exterior Door
1 Electric Strike
1 Threshold
1 Card Reader (provided by The Authority)
1 Power Supply
Balance of hardware specified in Section 08400

SET NO. 2

Single Exterior Door
1-1/2 Pair Butts
1 Card Reader (provided by The Authority)
1 Electric Strike
1 Lockset – Exit Function
1 Closer
1 Kick Plate
1 Head and Jamb Weatherstripping Set

1 Door Bottom
1 Threshold
1 Power Supply

SET NO. 3

Single Exterior Oversize Door
2 Pair Butts
1 Card Reader (provided by The Authority)
1 Electric Strike
1 Lockset – Store Room Function
1 Closer
1 Kick Plate
1 Head and Jamb Weatherstripping Set
1 Door Bottom
1 Threshold
1 Power Supply

SET NO. 4

Single Interior Door
1 1/2 Pair Butts
1 Lockset – Passage Function
1 Door Stop
3 Silencers

SET NO. 5

Single Interior Door
1 ½ Pair Butts
1 Lockset – Privacy Function with Occupancy Indicator
1 Closer
1 Kickplate
1 Door Stop
3 Silencers

PART 3 - EXECUTION

3.01 INSTALLATION

A. Hardware shall be installed accurately in accordance with the manufacturers' templates and approved instructions.

B. All knobs, levers, panic devices, push plates, pulls and other hardware shall be installed in accordance with the requirements of ANSI A117 and ADAAG.

END OF SECTION

SECTION 088000

GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The term "glass" includes prime, processed and fabricated glass products. "Glazing" includes glass installation and all materials used to install glass. Types of work include glass and glazing for:

1. Exterior aluminum entrance door, associated windows, and transom.

2. Exterior hollow metal door vision lights.

3. Glass for aluminum windows.

1.03 QUALITY ASSURANCE

A. Prime Glass Standard: Comply with FS DD-G-451.

B. Heat Strengthened and Fully Tempered Glass Standard: FS DD-G-1403.

C. Safety Standards for Hazardous Locations: Conform to requirements of Building Code which applies to the Project and to all local ordinances and regulations.

1.04 SUBMITTALS

A. Submit 2 samples, 12 inches square, of each glass type specified. Submit 12 inch lengths of installed (mocked-up) glazing systems including metal framing and sealant components. Submit insulating glass samples with completed edge seal construction. Hermetic seal need not be maintained.

B. Submit copies of manufacturer's specifications, product information sheets, warranties, and installation instructions and recommendations.

1.05 JOB CONDITIONS

Meet with glazier and other trades affected by glass installation prior to beginning of installation. Do not perform work under adverse weather or job conditions. Install liquid sealants only when temperatures are within lower or middle third of temperature range recommended by manufacturer.

1.06 SPECIFIED PRODUCT WARRANTY

A. Provide insulating glass manufacturer's written warranty, agreeing to, within specified warranty period, furnish FOB project site, replacement units for insulating glass units which have defective hermetic seals (excluding that due to glass breakage); defined to include intrusion of moisture or dirt, internal condensation at temperatures above -20°F (-31°C), deterioration of internal glass coatings, and other visual evidence of seal failure or performance failure; provided manufacturer's instructions for handling, installing, protecting and maintaining units have been adhered to during warranty period.

B. Warranty period is 10 years after seal date permanently imprinted on units, but in no case less than 9 years after the date of substantial completion.

PART 2 - MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Pilkington
PPG Industries, Inc.
Guardian Industries
Ford Glass Company

2.02 PRIME GLASS

Float Glass: Type I, Quality q3, clear or tinted glass as indicated.

2.03 PROCESSED GLASS

Tempered Glass: Provide clear or tinted glass as indicated, which has been heat treated to strengthen glass in bending to not less than 4.5 times annealed strength. Tong marks shall not be visible in glass after it is glazed in openings. Glass shall be of the thicknesses indicated, equal to Pilkington Tempered Glass. Color will be selected by the Architect.

2.04 FABRICATED GLASS UNITS

A. Laminated Safety Glass: Laminate 2 sheets of clear or tinted float or tempered glass (as specified) with a 30-mil interlayer of poly-vinyl butyral, by manufacturer's standard heat-plus-pressure process with dirt, air pockets and foreign substances excluded; 1/4 inch thick if not otherwise indicated. Units shall be equal to Pilkington Laminated Glass. Color will be Pilkington Artic Blue High Performance Tint.

B. Tinted Sealant-Edged Insulating Glass: Provide manufacturer's standard double-pane with a seal classification of "A" as tested and certified by IGCC, with a permanent hermetically sealed, dry air or gas filled space of width indicated, dual-sealed edge construction, edge seal consisting of twin primary sealant beads of polyisobutylene, positioned and retained by tubular aluminum spacer bar. Provide manufacturer's standard protective, rust resistant metal edge banding on insulating glass units, labeled with fabricator's name and date of seal. Units shall be equal to Pilkington Insulated Glass. Color will be Pilkington Artic Blue High Performance Tint.

2.06 GLASS TYPES

Provide the following glass types as indicated in the Glazing Schedule:

Type A - 1 inch tinted insulated: 1/4 inch tinted exterior light, 1/2 inch desiccated air space, 1/4 inch interior light.

Type B - Same as Type A but both lights tempered.

Type C - 1 inch obscured tinted insulated: 1/4 inch tinted exterior light, 1/2 inch desiccated air space; 1/4 inch clear obscure (frosted or sandblasted) interior light.

2.07 GLAZING SEALANTS AND COMPOUNDS

Provide color of exposed sealant/compound as selected by Engineer from manufacturer's standard colors. Comply with manufacturer's recommendations for selection of hardness, depending upon the location of each application, conditions at time of installation, and performance requirements. Carefully select materials for compatibility with surfaces contacted in the installation.

2.08 GLAZING GASKETS

A. Molded Neoprene Glazing Gaskets: Molded or extruded neoprene gaskets of the profile and hardness required for watertight construction. Glazing gaskets shall be standard for the glass framing systems supplied and shall be purchased from the frame manufacturer unless otherwise approved.

B. Vinyl Foam Glazing Tape: Closed cell, flexible, self-adhesive, non-extruding, polyvinyl chloride foam tape; recommended by manufacturer for exterior, exposed, watertight installation of glass, with only nominal pressure in the glazing channel; complying to ASTM D 1667.

2.09 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers and Sealers: Type recommended by sealant and gasket manufacturers.

B. Setting Blocks: Neoprene or EPDM, 70-90 durometer hardness, with proven compatibility with sealants used.

C. Spacers: Neoprene or EPDM, 40-50 durometer hardness, with proven compatibility with sealants used.

D. Compressible Filler (Rod): Closed cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

PART 3 - EXECUTION

3.01 STANDARDS AND PERFORMANCE

A. Watertight and airtight installation of each piece of glass is required. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating units) without failure, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects.

B. Protect glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with edge damage and other imperfections.

C. Glazing channel dimensions shown are intended to provide for necessary bite on glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

D. Comply with combined recommendations and technical reports of manufacturers of glass and glazing products as used in each glazing application, and with recommendations of Flat Glass Marketing Association "Glazing Manual," except where more stringent requirements are indicated or specified.

E. Install insulating glass units to comply with recommendations by Sealed Insulating Glass Manufacturers Association, except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

3.02 PREPARATION FOR GLAZING

A. Clean glazing channel and other framing members to receive glass immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

B. Apply primer or sealer to joint surfaces where recommended by sealant manufacturer.

3.03 GLAZING

A. Install setting blocks of proper size in sill rabbet, located 1/4 of the glass width from each corner. Set blocks in thin course of heel-bead compound.

B. Provide spacers inside and out, of proper size and spacing, for glass sizes larger than 50 united inches, except where gaskets or preshimmed tapes are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

D. Miter cut and bond ends together at corners where gaskets are used for channel glazing so that gaskets will not pull away from corners and result in voids or leaks in the glazing system.

3.04 CURING, PROTECTION AND CLEANING

A. Protect glass from breakage immediately upon installation. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean surfaces. Cure sealants as necessary to provide high early strength and durability.

B. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

C. Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspection intended to establish date of Substantial Completion. Comply with glass manufacturers' recommendations for final cleaning.

END OF SECTION

SECTION 092900

GYPSUM BOARD AND METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. This section provides minimum standards for gypsum drywall work. The work required consists of furnishing all materials, equipment, accessories, labor and supervision, and performing all operations necessary to provide finished gypsum drywall work as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

B. Without in any way limiting the work to be performed, the following gypsum drywall work items are mentioned:

1. Gypsum board and metal furring over concrete masonry units.

2. Gypsum board and metal drywall framing for partitions and fire rated ceilings.

3. Drywall finishing of gypsum boards (joint tape-and-compound treatment).

4. Ceiling access doors.

5. Cement backer panels for ceramic tile.

1.03 QUALITY ASSURANCE

A. Gypsum Board Standard: GA-216 by Gypsum Association.

B. Metal Support Standard: ASTM C 754.

C. Manufacturer: Obtain gypsum board products and accessories from a single manufacturer, or from manufacturers recommended by the manufacturer of gypsum boards.

D. Allowable Tolerances: 1/16" offsets between planes of board faces, and 1/8" in 8'-0" for plumb, level, warp and bow.

1.04 SUBMITTALS

Submit manufacturer's product specifications and installation instructions for each gypsum drywall material (i.e., gypsum board, furring, etc.), component, including other data as may be required to show compliance with these specifications.

1.05 PRODUCT HANDLING

Deliver, identify, store and protect gypsum drywall materials to comply with Gypsum Association Specification GA-216.

PART 2 – MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are listed in the following paragraphs.

2.02 METAL SUPPORT MATERIALS

A. Furring Members: ASTM C 645; 20 gage, hat-shaped (C-shaped studs in some locations).

B. Studs: ASTM C 645; 20 gage unless otherwise indicated. Studs, runners and accessories in or abutting exterior walls shall be galvanized; otherwise primed. Studs shall be 3-5/8” except as otherwise indicated. Studs at designated plumbing walls shall be 6”. Runners shall be the type recommended by stud manufacturer for floor and ceiling support of studs, and for abutment of drywall work at other work. Provide stud manufacturer’s standard clips, ties, reinforcements, fasteners, grommets, and other accessories as needed for a complete stud system.

C. Fasteners: Type and size recommended by furring manufacturer for the substrate and application indicated.

D. Manufacturers: Provide materials by one of the following firms:

Allied Structural Industries
Dale Industries, Inc.
United States Gypsum Co.

2.03 GYPSUM DRYWALL

A. Gypsum Drywall and Related Products:

Provide materials by one of the following firms:

The Flintkote Company
Gold Bond Building Products Div., National Gypsum Co.
United States Gypsum Co.
Georgia-Pacific

B. Exposed Gypsum Drywall: Regular type with tapered long edges.

Thickness: Provide gypsum drywall of the thicknesses indicated on the Drawings. Where not indicated, comply with thickness requirements of GA-216 for each application and support spacing. Comply with requirements for indicated fire-resistance ratings.

Sheet Size: Maximum length available which will minimize end joints.

Insulating Type: Provide in all exterior walls (aluminum foil backing).

Type WR: Provide in Toilet and Storage.

Type X: Provide at Fire Rated assemblies and as indicated.

C. Cement Backer Panels for Ceramic Tile: Provide Durock brand by United States Gypsum Company.

2.04 TRIM ACCESSORIES

Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, special L-kerf-type edge trim-beads, and one-piece control joint beads.

2.04 JOINT TREATMENT MATERIALS

A. ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise noted.

B. Joint Tape: Perforated or plain type.

C. Joint Compound: Provide chemical-hardening-type for bedding and filling, ready-mixed vinyl-type or vinyl-type powder for topping.

2.05 MISCELLANEOUS MATERIALS

A. Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the gypsum board manufacturer.

B. Gypsum Drywall Fasteners: Comply with GA-216.

2.07 ACCESS DOORS

Ceiling hatch shall be 2-hour fire rated (2'-0" X 2'-6") with 16 gauge galvanized steel frame and 20 gauge galvanized steel upward acting door. Door shall be insulated with 1 inch minimum thickness mineral wool insulation. Door shall be equipped with a spring lever, as manufactured by Babcock-Davis, Bilco Co., Cedrex/Intertek, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION FOR METAL SUPPORT SYSTEMS

A. Coordinate work of this section with other work to ensure that all inserts and other items have been provided for.

B. Furnish concrete inserts, clips and similar devices to other trades for installation well in advance of time needed for such other work.

3.02 INSTALLATION OF METAL SUPPORT SYSTEMS

A. Do not bridge building expansion joints with furring system; frame both sides of joints with furring.

B. Space wall furring members 16" o.c., except as otherwise indicated.

C. Install supplementary framing, runners, furring, blocking and bracing at openings and terminations in the work, and at locations required to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported directly on gypsum drywall alone.

3.03 GENERAL GYPSUM DRYWALL INSTALLATION REQUIREMENTS

A. Pre-Installation Conference: Meet at the Project site with the installers of related work and review the coordination and sequencing of work to ensure that all work to be concealed by gypsum drywall has been accomplished and approved.

B. Locate exposed end-butt joints as far from center of walls as possible, and stagger not less than 1'-0" in alternate courses of drywall.

C. Install drywall boards vertically to avoid end-butt joints wherever possible.

D. Install exposed gypsum drywall board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.

E. Locate edge joints over supports. Position boards so that tapered edges abut, and mill-cut or field-cut ends abut. Do not place tapered edges against cut edges or ends.

F. Attach gypsum drywall to framing and blocking as required for additional support at openings and cutouts.

G. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

3.04 METHOD OF GYPSUM DRYWALL APPLICATION

Apply gypsum boards to supports with recommended screws. Follow the manufacturer's recommendations for single layer applications.

3.05 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports. Otherwise, fasten flanges by screwing in accordance with manufacturer's instructions and recommendations.

B. Install metal corner beads at external corners of drywall work.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type where edge is exposed, revealed, gasketed, or sealant-filled.

D. Install metal control joint (beaded-type) where indicated.

3.06 ACCESS DOORS

Install access doors in the locations shown, in strict accordance with the manufacturer's instructions and recommendations.

3.07 DRYWALL FINISHING

A. Apply drywall treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for subsequent application of finishes. Prefill open joints and tapered edges, using type of compound recommended by manufacturer.

B. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated or required.

C. Apply joint compound in 3 coats (not including prefill of openings in base), and sand between coats and after last coat.

D. Drywall finishing shall be performed so that all joints, fastener locations, trim flanges, etc., are indiscernible after painting.

E. Refer to Section 099123 for painting finishes to be applied to drywall work.

3.08 PROTECTION OF WORK

Protect gypsum drywall work from damage and deterioration during the entire construction period.

END OF SECTION

SECTION 093013

CERAMIC TILING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, supplies, transportation, labor and supervision, and performing all operations required to install all ceramic tile work as shown on the Drawings and schedules, as specified herein, and as is additionally required to properly complete the work.

1.03 SPECIFIED ELSEWHERE

A. Cement backer board for ceramic tile - Section 092900

B. Toilet, bath, and laundry accessories - Section 102800

1.04 GENERAL REQUIREMENTS

A. Ceramic mosaic floor tiles over concrete and glazed ceramic wall tiles over gypsum board shall be manufactured by American Olean Tile Co., United States Ceramic Tile Co., or Dal-Tile.

B. Deliver all materials to the site in manufacturers' unopened containers with grade seals unbroken and labels intact; keep tile cartons dry.

C. Maintain temperature at 50^{o}F. minimum during tile work and for 7 days after completion.

D. All work shall be installed in strict accordance with the requirements of the latest revision of the Tile Council of America (TCA), "Handbook for Ceramic Tile Installation".

1.05 SUBMITTALS

A. The Contractor shall submit samples of the tiles to the Resident for selection and approval.

B. Submit copies of manufacturers' specifications and installation instructions for each material required.

1.06 MAINTENANCE STOCK

A. Provide 1 full box of each type of tile and any non-installed full tiles to the Owner at final completion for Owner’s use as maintenance stock.

PART 2 - MATERIALS

2.01 CERAMIC FLOOR TILE

A. Tile shall be “Ayers Rock” by Daltile. Tile shall be colorbody, impervious porcelain type, 5/16 inch thick. Tile shall be standard colors, all as selected from samples submitted to the Architect. Tile size shall be 13” x 13”.

B. Tile shall be standard grade conforming to ANSI A137.1.

2.02 GLAZED CERAMIC WALL TILE

A. Tile shall be “Unity” by Daltile. Tile shall be polished colorbody impervious porcelain type, 5/16 inch thick. Tile shall be standard colors, all as selected from samples submitted to the Architect. Tile size shall be 12” x 24”.

B. Tile and base shall be standard grade conforming to ANSI A137.1.

2.03 DRY SET MORTAR

Dry set mortar shall conform to ANSI A118.1.

2.04 GROUTING MATERIAL

Grouting material shall conform to ANSI A118.6. Color of grout for walls and floors shall be selected by the Architect. Grout shall have integral sealer component.

2.05 SEALANT

Sealant shall be #784 white silicone as manufacturer by Dow Corning Co. Similar sealant by General Electric may be submitted for the Engineer's approval.

2.06 METAL TRIM UNITS

Provide metal trim units with cove profile at wall and floor interior corner transitions. Provide flat edge metal trim units at top of wall tile. Similar to Schluter brushed stainless steel finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Before tiling, be sure variations of surface to be tiled is not more than 1/8 inch in 8 feet for walls and 1/8 inch in 10 feet for floors and that all plumbing fixtures, fittings and connections are in place and surfaces are free of curing membranes, oil, grease, wax and dust.

B. Tile applied shall be properly spaced, and set true, plumb and straight.

C. Install metal trim strips at all tile interior corners in walls and floors and wall top cap.

D. Ceramic tile shall be set with dry set mortar conforming to ANSI A108.5.

1. Floor: TCA Method F113.

2. Wall: TCA Method W202.

E. Grout shall be placed and thoroughly worked in to all tile joints to form a smooth dense surface free of voids. Clean all tile surfaces with water as soon as grout becomes firm.

F. Where tile abuts steel, wood or other material, seal the joint with sealant.

G. It will be the responsibility of the tile contractor to protect the work in this section and the work of others from damage resulting from this work. Damaged items shall be refinished, replaced or repaired, as determined by the Engineer, at no additional cost.

H. Cover tile completely with heavy reinforced non-staining sisal kraft paper, lapped a minimum of three inches, with joints sealed and taped. No traffic shall be allowed on tile floor for at least three days after installation.

END OF SECTION

SECTION 09123

ACOUSTICAL TILE CEILINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, supplies, incidentals, labor and supervision, and performing all operations required to furnish and install all lay-in suspended ceiling components as shown on the schedules and Drawings, and as specified herein and as is additionally required to properly complete the work.

1.03 GENERAL REQUIREMENTS

A. All ceilings shall be installed in accordance with the approved instructions of the manufacturer of the suspension system and ceiling panels.

B. All overhead mechanical and electrical work, excluding surface mounted equipment, shall be completed and in-place prior to the installation of the ceilings.

C. Installation of lay-in ceiling panels shall not begin until residual moisture from concrete and masonry work has dissipated. Before installation, the building shall be enclosed and permanent heating equipment in operation.

1.04 SUBMITTALS

A. One linear foot of main runner, cross tee, edge molding and hanger wire.

B. One square foot of panel.

C. Shop drawings shall be submitted and approval obtained prior to delivery of ceiling system components to the site. Drawings shall clearly delineate all components of the system and shall show proposed layout of ceiling grid.

D. Submit manufacturer’s product data for all materials.

1.05 MAINTENANCE STOCK

A. Provide 1 full box and any non-installed ceiling tiles to the Owner at final completion for Owner's use as maintenance stock.

PART 2 – MATERIALS

2.01 MATERIALS

A. All materials shall be delivered in their original unopened packages.

B. Hanger wires shall be galvanized carbon steel, ASTM A 641, soft temper, prestraightened, prestretched, yield-stress load of at least 3 times design load but not less than 12 gage. Wire coils will not be permitted.

C. Ceiling panels shall be 24" x 48" x ¾" thick regular lay-in type commercial ceiling tile "Dune Second Look II (2712) by Armstrong World Industries, conforming to Class A (Fed. Spec. SS-S-118B) flame spread rating. No substitutions allowed.

D. Suspension system shall be an exposed interlocking grid assembly complying with ASTM C 635, Standard Specification for Metal Suspension Systems for "Acoustical Lay-in Panel Ceilings." Suspension system shall be classified heavy duty. Exposed members shall have a factory applied low gloss white baked enamel finish. System shall be "Prelude ML" by Armstrong World Industries or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with ASTM Recommended Practice C 636. Grid system shall be true, straight and level to a tolerance of one in 1000, with border units of the greatest possible size. Install hangers directly to supporting structure. All members and panels shall be installed in strict accordance with the manufacturer's recommendations. All joints around electric outlets, ducts, pipes and other work extending through the ceiling treatment shall be sealed tight with Engineer approved nonhardening caulking compound. At completion of the ceiling treatment, joints in grid shall be straight and true-to-line, with exposed surfaces flush and level with hairline joints. Units shall be neatly jointed to connecting work. Provide angles at intersections of all vertical surfaces.

B. Following erection, dirty and discolored surfaces of acoustical units and/or support system shall be cleaned in accordance with the manufacturer's recommendations and left free from defects. Grid components and acoustical tiles that are damaged in any way or improperly installed shall be removed and replaced as directed, at no additional cost.

END OF SECTION

SECTION 096513

RESILIENT BASE & ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work includes furnishing all materials, equipment, supplies, labor and supervision, and performing all operations required to provide resilient accessories as shown on the Drawings, as specified herein and as is additionally required to properly complete the work. Location of wall base and accessories are shown or scheduled on the Drawings.

1.03 QUALITY ASSURANCE

Provide each type of resilient accessory as produced by a single manufacturer, and include manufacturers' recommended primers, adhesives, sealants, leveling compounds, etc.

1.04 SUBMITTALS

A. Product Data: Submit 8 copies of manufacturer's technical data and installation instructions for each type of resilient wall base, accessory, and installation materials such as adhesive, leveling compound, etc.

B. Samples: Submit samples of each type, color, and pattern of resilient wall base, and accessory required, indicating full range of color and pattern variations. Provide 6" long sections of wall base and accessories.

For initial selection of colors and patterns submit, prior to above, samples in form of actual sections of resilient wall base and accessory, showing full range of colors and patterns available for each.

C. Certification for Fire Test Performance: Submit manufacturer's certification that resilient wall base and accessories furnished comply with required fire test performance and have been tested and meets indicated standards.

D. Maintenance Instructions: Submit 8 copies of manufacturer's recommended maintenance practices for each type of resilient wall base and accessory required.

1.05 JOB CONDITIONS

Maintain minimum temperature of 65ºF (18ºC) in spaces to receive resilient wall base and accessories for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55ºF (13ºC) in areas where work is completed.

Where possible, install resilient wall base and accessories after other finishing operations, such as painting, have been completed.

1.06 MAINTENANCE STOCK

A. Provide Owner will all non-installed undamaged product in original packaging at the completion of the work

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide products of one of the following manufacturers:

Armstrong Company, Floor Division
Azrock Industries, Inc., Floor Division
Burke Industries Inc.
Flexco
Johnsonite; a Tarkett Company
Kentile Floors, Inc.
Roppe Corporation, USA
VPI Corporation

2.02 MATERIALS

A. Colors and Patterns: As selected by the Architect from the manufacturer's standards.

B. Vinyl Wall Base: Standard straight base 1/8 inch thick by 4 inches high, with preformed or molded corner units, matte finish.

C. Adhesives (Cements): Waterproof stabilized type as recommended by resilient materials manufacturers to suit material and substrate conditions.

PART 3 - EXECUTION

3.01 PREPARATION

A. Broom clean or vacuum surfaces to be covered and inspect substrate. Start of installation indicates acceptance of conditions and full responsibility for completed work.

3.03 INSTALLATION OF WALL BASE AND ACCESSORIES

A. Apply vinyl wall base to walls, casework and other permanent fixtures and vertical surfaces in rooms or areas where base is required, including closets. Install base in lengths as long as practicable, with preformed or molded corner units. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.

3.04 CLEANING AND PROTECTION

A. Remove excess adhesive and other surface blemishes using neutral type cleaners as recommended by manufacturer.

B. Finishing: After completion of the work, just prior to inspection of the work for Substantial Completion, thoroughly clean floors, wall base and accessories.

END OF SECTION

SECTION 099123

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

A. The work includes furnishing all materials, equipment, tools, supplies, transportation, staging, drop cloths, wet-paint signs, labor and supervision, etc., and performing all operations required for interior and exterior "on site" painting as noted on the Drawings, as described herein, and as is additionally required to properly complete the work.

B. Unless otherwise indicated in the Paint Schedule, prepare surfaces and apply the number of coats scheduled herein regardless of shop or field coats specified elsewhere. Surface preparation and touch-up of shop coats is included in the work.

C. In general, it is intended that all non-shop finished exposed surfaces throughout the interior and exterior of the building be painted as described herein and as indicated on the Drawings.

1. Except as otherwise noted or directed by the Architect, the following are not to be painted: bronze; stainless steel; aluminum and other non-ferrous metals; prefinished metals; concrete sidewalks; finish hardware; glass and glazing materials; acoustical ceilings; resilient floor/wall coverings and base; plastic laminate; lighting units and pipes, ducts, conduit, insulation, etc., in mechanical rooms except where they abut surfaces scheduled to be painted.

2. Except as otherwise noted, paint all steel doors, steel door and louver frames; exposed structural steel and miscellaneous metals, interior and exterior; gypsum board walls; exposed concrete masonry units; exposed interior concrete; standing and running trim; shelving and drawers in casework; exposed rough carpentry work (e.g., plywood, back-up panels etc.); all exterior woodwork; back-priming all exterior woodwork; piping/conduit, hangers, supports, and related equipment and accessories in areas designated to be finish painted (except where finish painted by the manufacturer or specifically excluded by this specification, the Drawings or the Architect).

D. The Contractor shall perform all work in accordance with this Specification Section and shall complete all incidental details, whether or not such details are specified herein, as is required to produce thoroughly finish painted work of the best quality.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All paints and associated materials shall be first quality products manufactured by the following companies:

Benjamin Moore
Dur-A-Flex
Tnemec Company, Inc.
Sherwin Williams

B. Insofar as possible, paints used for this Contract shall be produced by a single manufacturer.

C. All materials used in the work are to be of the best of their brand or class, brought to the site in original unopened containers. Containers of materials must have original labels intact in order to be accepted for use on the Project. Driers, thinners and solvents shall be as recommended by the manufacturer of the paint being used.

D. No claim as to the unsuitability of any material used will be considered unless such claim is made in writing before the materials are approved by the Resident. By submitting a product for approval, the Contractor assumes complete responsibility for the suitability of the paint and for the results obtained therewith.

E. The Schedule of Painting listed herein designates specific manufacturers to denote the standard of quality and the type of finish desired. Materials of other manufacturers listed above shall be submitted to the Engineer for approval prior to purchase of any materials. Requests for substitution shall list the material specified and the specific material being offered as a substitute, including appropriate supportive technical data.

2.02 COLORS AND FINISHES

A. All colors and finishes shall be as selected and/or scheduled by the Architect. Prepare for approval by the Architect, two (2) panels for each color and finish selected (i.e., semi-gloss, flat, etc.). Submit these samples at least 3 weeks in advance of the date scheduled for beginning painting work.

B. Panels shall be at least 12 inches by 12 inches.

C. Approved samples shall be kept in the Contractor's field office for reference for the duration of the painting work.

2.03 GENERAL REQUIREMENTS

A. Inspect all surfaces requiring painter's finish and remedy all remaining defects.

B. All surfaces to be painted shall receive a prime coat and two finish coats, unless otherwise noted.

C. Take adequate precautions for protection against soiling and damage to adjacent equipment, structures, and surfaces. Protect floors, paved areas and all other adjacent surfaces against spatter and spillage. Leave and maintain protection in place until all final painting has been performed and approved in the affected area.

D. Erect, maintain and dismantle scaffolding and access equipment without damage to structures, machinery, pipes, etc.

E. Store rags, cleaning cloths, and waste materials smeared or contaminated with paint, oils, solvents, and other flammable materials in approved covered metal containers and remove them from buildings and dispose of them off-site after each shift and as otherwise directed by the Resident.

F. Take precautions so that surface preparation, including dust blow-off, does not do any damage. With the approval of the Resident, equipment, machinery and items that could be damaged by grit and dust may be masked and sealed dust-tight in a suitable manner. Take precautions so that grit and dust does not fall on surfaces ready for painting or onto newly painted surfaces.

G. As necessary, remove solvent and paint fumes by suitable means.

H. Do not perform spray painting in areas where welding is in progress nor near operations involving open flames, sparks or high heat.

I. Do not perform painting near or on energized electrical equipment or rotating equipment without proper precautions being taken nor until approval to proceed is received from the Engineer.

J. Take all necessary precautions to ensure that paint is not introduced into working parts of equipment, machinery, filters, motors, controls, etc. Where the indicated application method may cause damage, notify the Resident so that the Resident and manufacturer can agree on an alternate method of application.

K. Mask and otherwise protect nameplates, gauges, glass, fire rating labels, instructions, lubrication fittings, instruments and similar items as necessary to retain their original conditions after completion of the painting work. Remove protection after painting is completed.

L. Follow the manufacturers' recommendations and OSHA regulations regarding precautions and protective clothing and equipment to be used by painters.

M. Adequately provide for the proper electric and static grounding of spray equipment, of items being painted and other static-producing equipment and electrical tools. The motors on painting and coating related equipment shall be explosion proof. Supply all ventilation equipment, respirators, safety lines, and eye, face, head and body protection.

N. The Contractor shall be responsible for all damage done to other work and for repairing same to the satisfaction of the Engineer. Replace all materials damaged to such an extent that they cannot be restored to their original condition. This work shall be done at the Contractor's expense.

2.04 SUBMITTALS

Submit 8 copies of the manufacturers' technical information including paint label analysis and application instructions for each material proposed for use.

2.05 DELIVERY AND STORAGE

A. Deliver all materials to the jobsite in original, new and unopened packages and containers bearing the manufacturer's name and label. Technical data sheets covering use of the product shall be included with every consignment delivered. Each container shall bear the label of the manufacturer and be clearly marked in a durable manner to show the following information:

1. Type of paint by generic description.

2. Manufacturer's paint name and reference number.

3. Gross and net weights and/or volumes.

4. Date of manufacture and shelf-life.

5. Recommended thinner and mix ratios.

6. Recommended safety precautions and antidotes in case of contact or ingestion.

B. Store materials in an enclosed, protected storage area with provisions for maintaining the materials in storage at not less than 60^{o}F nor more than 95^{o}F unless more restrictive temperatures are required by the paint manufacturer to guarantee shelf-life. Provide adequate ventilation in storage areas. No paint stored longer than the manufacturer's specified shelf-life shall be used in the work. Keep the storage space neat and clean and repair all damage to the space and surroundings.

PART 3 - EXECUTION

3.01 APPLICATION CONDITIONS

A. Apply water-base paints only when the temperature of the surface to be painted and the surrounding air temperature is between 50ºF and 90ºF., unless otherwise permitted by the paint manufacturers' printed instructions.

B. Apply solvent thinned paints only when the temperature of the surface to be painted and the surrounding air temperature is between 45º and 95ºF., unless otherwise permitted by the paint manufacturers' printed instructions.

C. Do not apply paint in snow, rain, fog or mist, or when the relative humidity exceeds 85%. Do not apply paint to damp or wet surfaces nor when the temperature of the surface to be painted is lower than the corresponding wet-bulb temperature for the existing air temperature and relative humidity, unless otherwise permitted by the paint manufacturers' printed instructions.

D. Continue painting during inclement weather only if the areas and surfaces to be painted are enclosed and maintained within the temperature and humidity limits specified by the paint manufacturer during both the application and drying periods.

E. Do not perform exterior painting when windblown dust or debris may contaminate the work. Isolate interior painting areas as required to prevent dust circulation. Provide temporary closures where isolation cannot be effected by closing doors and windows.

F. Prepare trial coats as requested by the Resident for coats differing in color, shade, application method, etc.

G. Each coat of paint must be dry before the succeeding coat is applied or any surface preparation (i.e., sandpapering) is done.

H. Perform painting and finishing in the best and most workmanlike manner known to the trade. No paint shall be applied by other than skilled workmen. All surfaces are to be left smooth, even and free from brush marks and visible paint laps. If surfaces are not thoroughly covered, apply additional coats or otherwise remedy problems until finished surfaces are of an acceptable uniform color, texture and sheen, at no additional cost.

I. Provide specified and approved finish coats which are compatible with prime paints. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coating system for various substrates. Upon request from other trades, furnish information on the characteristics of finish materials proposed for use to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove primer and reprime as required. Notify the Resident in writing of any anticipated problems using the specified coating systems over substrates primed by others.

J. If a prime coat does not dry to a uniform sheen over the entire surface, spot prime the areas that indicate suction before applying the finish coat.

K. After the first coat is applied, if the surface is not smooth, sand and refinish it.

L. Maintain a record, in a form approved by the Resident, of all painting work performed. Indicate on the record the locations and types of surfaces painted, manufacturers' stock numbers, color numbers, quantity of each paint type applied, surface preparation, and the number and mil thickness of each coat applied.

3.02 INSPECTION

A. Examine the areas and conditions under which painting work is to be applied and notify the Resident in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Commencement of painting work will be construed as the Contractor's acceptance of the surfaces and conditions within that particular area.

3.03 SURFACE PREPARATION

A. General:

1. Perform surface preparation and cleaning procedures in strict accordance with the paint manufacturers' instructions and recommendations, and as is additionally specified herein.

2. Thoroughly inspect, clean and repair all surfaces which have received a shop coat of paint under other sections of the specifications prior to application of additional coats. Where shop primer has been damaged, the field painting work includes surface preparation and touch-up painting of abraded and otherwise defective primer, as well as priming of uncoated field welds, field bolting, and all other bare surfaces before application of the first field coat. Feather edges of sound primer into defective prime areas, bare field welds, etc., and apply touch-up paint to overlap the adjacent sound primer by at least 2 inches.

3. Provide non-damaging protection for all hardware, hardware accessories, machined surfaces, plates, and similar items in place which are not to be finish painted, prior to surface preparation and painting operations.

4. Clean all surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning and painting operations so that contaminants from the cleaning process will not fall onto newly cleaned or newly painted surfaces.

5. Failure on the part of the Contractor to remedy surface imperfections that remain visible following the finish coat of paint shall be cause for rejection, solely at the discretion of the Engineer, and shall be considered due cause for refinishing the surface area involved by the Contractor, at no additional cost.

6. Cut out and fill with spackle or other approved compounds, all scratches, cracks, abrasions, etc., adjoining trim materials. Make all patches flush with adjoining surfaces and allow to dry and then properly seal before application of the prime coat. In general, interior caulking and sealants will be installed prior to start of field painting; however, certain sealants require that painting be applied first. It shall be the Contractor's responsibility to coordinate such work with the trades involved.

B. Specific Surface Preparation: The painting systems will indicate one or more of the following methods of surface preparation for each item or surface to be painted.

1. Solvent Cleaning: Cleaning in accordance with Steel Structures Painting Council (SSPC) Specification SP 1.

2. Alkaline Cleaning: Wash with weak alkaline solution consisting of 1 part trisodium phosphate to 32 parts of water, rinse thoroughly with clean, potable water, and dry.

3. Masonry and Concrete: (Concrete Block and Concrete) - remove all form oil, dust, dirt, efflorescence, chalk, loose material, laitance, etc., by wire brushing, stone rubbing and other appropriate means (use of acid cleaners must be approved by the Engineer). Comply with paint manufacturers' recommendations regarding neutralizing surface for oil base paints or wetting for water base paints. Patch all ratholes and rough spots with an Engineer approved compound. Keep patches damp (where applicable) for a period of at least 24 hours and then allow to dry thoroughly prior to application of paint. Patch in a neat and workmanlike manner. Test each patch for adhesion before painting. Do not paint new concrete and masonry for at least 28 days after placement to permit the concrete and mortar to cure and dry out sufficiently.

4. Wood and PVC Surface: Perform alkaline cleaning to remove grease, oil, wax, etc. Remove alkali solution with water soaked wipers and then dry the surfaces. Smooth surface by fine sanding. Blunt sharp edges with light hand sanding. Seal knots and pitch streaks with shellac. For surfaces which are to receive an opaque finish, fill holes, cracks, etc., with a latex base compound and when hardened, sand smooth. In areas where the wood is to be stained, mix proper colored stain with the wood filler before application to ensure color match of the filler to surrounding woodwork. Do not apply paint or stain to unfinished wood having a moisture content of more than 10% (at a minimum 3/16 inch depth) as checked by a Painter's Moisture Register - Model 9.

5. Ferrous Metals: Clean iron and steel surfaces that have not been previously shop coated, and which do not require sand blasting, of rust and scale in

accordance with Steel Structures Painting Council Specification SP-3, Power Tool Cleaning, prior to application of prime coat. Prior to mechanical cleaning, solvent or alkaline clean surfaces to remove oil, grease, and other contaminants. Clean surfaces the same day the surfaces are to be painted. Take special care to avoid burnishing surfaces by wire brushing.

6. Galvanized Surfaces: Solvent clean and scrub with scouring pads to remove all oil and "white rust". Follow by rinsing with clean, water soaked wipers, and then dry the surfaces. When required (i.e., prior to application of alkyd coatings), apply a "wash primer" in accordance with the paint manufacturers' recommendations.

7. Preparation for Touch-up Painting: Clean all field bolting, field welds, unprimed steel, and all other miscellaneous uncoated metal of rust, scale, welding contaminants, grease, oil and other foreign matter by alkaline and power tool cleaning. Remove all weld spatter, sharp edges and points by chipping and grinding. Remove damaged primer until sound primer is encountered. Feather the edge of paint surrounding damaged areas and overlap adjacent sound primer by at least 2 inches with touch-up primer.

8. Drywall (Gypsum Board): Prepare all drywall surfaces so that there are no cracks, holes or other physical damage present, nor any chalkiness, insufficiently slaked lime, excessively porous surfaces, crazing, joint compound fins and holidays. Do not apply any paint to plaster or drywall surfaces when the surface moisture, as measured by Painter's Moisture Register - Model 9, exceeds that allowed by the paint manufacturer.

3.04 MATERIALS PREPARATION

Mix and apply paint in compliance with the manufacturer's directions. Thoroughly stir paint materials until the ingredients therein are completely intermixed and, if necessary, strain prior to application. Do not mix any surface film into the paint. If required, use thinners furnished or recommended by the paint manufacturers for the specific materials and application conditions. Do not use thinner in excess of the manufacturer's recommendations. Proportion and prepare catalyzed paints in exact accordance with the manufacturer's directions. Make sure that personnel mixing paint are knowledgeable of the products being mixed.

3.05 APPLICATION

A. In general, the painting systems specifications indicate the required method of application; brush, roller or spray. Where spray equipment is required, the equipment and application pressures shall conform to the paint manufacturer's recommendations, and shall be subject to acceptance by the Engineer. Where the indicated application method is not feasible or appropriate, obtain the Engineer's acceptance of an alternate method. Bring to the attention of the Engineer all discrepancies between these specifications and manufacturers' instructions and recommendations, and await the Engineer's decision of resolution before proceeding with the work in question.

Where more than one method of application is given, use the method recommended by the manufacturer for the particular application.

B. Use only tools and equipment which are suitable, clean, in good condition, and recommended by the paint manufacturer. Spray equipment shall produce proper atomization and leave a satisfactory film on the surface. Do not leave brushes and rollers to harden before cleaning. Do not use paint mitts.

C. Apply paint as necessary to produce tough, durable and well-bonded films that will provide long-term protective performance and satisfactory appearance. Apply paint to produce a uniform thickness, free of defects such as pinholes, holidays, skips, missed areas, blistering, runs, sags, wrinkles, excessive film build-up, lack of film build-up, uneven film thickness, bubbles, cratering, cracking, crazing, poor adhesion, delamination, lifting, peeling, dry spray, overspray, excessively thinned coatings, contaminated coatings, flatting, orange peel, brush marks, solvent traps, and embedded dust and dirt.

D. Do not apply paint to a surface that has not been properly prepared, nor when the ambient and surface conditions are not satisfactory. Do not apply paint at humidities and temperatures that will cause blistering, porosity or be otherwise detrimental to the performance and life of the paint. Provide suitable air and surface thermometers, sling psychronometers, etc., at the jobsite as are essential for the work to monitor temperature and humidity conditions.

E. As paint application is in progress, check each coating frequently by means off suitable wet film thickness gauge to achieve the proper dry film thickness, taking in to account theoretical coverage versus actual coverage, as well as solvent loss.

F. Strictly adhere to the manufacturers' recoat time. Do not apply paint over undercoats which have not properly cured. Conversely, adequately and properly prepare surfaces of paints which have cured past their critical recoat time. Before painting, prepare and repair undercoats deteriorated from long exposure to the weather or other adverse conditions.

G. Use the cross-spray technique to insure uniform coverage, free of defects and missed areas. "Stripe paint" sharp edges to ensure proper build-up at the edges, prior to the application of the specified number of coats.

H. Do not force dry paint.

I. Protect newly painted surfaces from rain, condensation, dirt, debris, and other contamination until paint has cured.

J. Apply additional top coats when undercoats, stains and other conditions show through the final coat. Take care to insure that all surfaces, including edges, corners, crevices, welds, exposed fasteners, etc., receive a dry film thickness equivalent to that of flat surfaces. To insure this, stripe or spot paint such areas first and then recoat as the remainder of the surface is being painted.

K. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.

L. Paint interior surfaces of ducts that are visible through registers and grilles with an appropriate flat finish black paint.

M. Paint the back and sides of access panels and removable and hinged covers to match the exposed surfaces.

N. Finish tops and edges of exterior doors the same as the "pull" side faces.

O. Sand lightly between coats if recommended by the manufacturer.

P. If the dry film thickness at any of the inspection times is less than specified, apply an additional coat of the material specified, or increase the film thickness of the succeeding coat or coats, at the discretion of the Engineer, as required to ensure that the specified total dry film thickness for the finished work is obtained. Conceal all brush marks, laps, and joints between successive work days.

Q. Scheduling Painting:

1. Before applying paint, remove all dust, grit, loose rust particles, dirt, etc., from surfaces by vacuuming or blowing off with dry, oil-free air, as appropriate for the application.

2. Apply paint as soon as possible after the surfaces have been cleaned, pretreated, or otherwise prepared for painting, and before subsequent surface deterioration.

3. Allow sufficient time between coats to permit proper drying.

3.06 RETOUCHING

A. Touch-up all work painted under this Contract which, for any reason, has been damaged during construction work.

B. It is required that all finish work have acceptable surfaces when the building is ready for acceptance by the Engineer.

3.07 CLEAN-UP AND PROTECTION

A. Upon completion of painting work, clean all paint-spattered surfaces. Remove spattered paint by approved methods, using care not to scratch or otherwise damage finished surfaces.

B. Correct all damage caused by cleaning, repairing, replacing, and repainting, as acceptable to the Engineer.

C. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.08 "AS-BUILT" RECORD

Submit, for record purposes, a finish paint schedule for each area and surface receiving "painter's finish", indicating actual paints applied, including manufacturer, type, gloss, color blend, etc.

3.09 GUARANTEE

Give the Authority a written guarantee that the materials and workmanship are of the highest quality and that the paint will not discolor, fade, peel, chalk, craze, chip, alligator, etc., and that any work which becomes defective within one (1) year of acceptance of the work will be promptly made good by the Contractor to the satisfaction of the Authority without cost.

3.10 PAINT SYSTEMS AND SCHEDULE

A. The following paragraphs list the various paint systems to be used for the work, and most of the major items and surfaces requiring painting. The mention of specific items and surfaces to be painted shall not be construed as limiting the total number of items and surfaces that are to be painted. The intent of this section is to have all items and surfaces painted as specified for other materials in the same environment, except for those items which are specifically excluded.

B. Systems

1. System A(1) - (Gloss Alkyd)

a. Surface Preparation: For bare metal, alkaline clean, Power Tool Clean and solvent clean in accordance with SSPC SP-3 and SSPC-SP-1.

b. Touch-up: Prepare damaged galvanizing with ZRC Cold Galvanizing Compound or equal and prime all galvanizing with Tnemec 151-1051 Elasto-Grip.

c. Prime Coat: Prime touch-up areas and bare metal with Tnemec Series v10 Rust Inhibitive Primer.

d. Finish Coat: Two coats of Tnemec Series 2H Hi-Build Tneme-Gloss Alkyd Enamel; 2.5 to 3.5 dry mils each coat (spray, brush or roller applied).

2. System A(2) - (Semi-Gloss Alkyd)

a. Surface Preparation: For bare metal, alkaline clean, Power Tool Clean and solvent clean in accordance with SSPC SP-3 and SSPC-SP-1.

b. Touch-up: Prepare damaged shop primer and galvanizing in accordance with touch-up specifications.

c. Prime Coat: Prime touch-up areas and bare metal with Benjamin Moore Corotech Acrylic Metal Primer (V110).. Repair damaged galvanizing with ZRC Cold Galvanizing Compound or equal, and prime all galvanizing with Benjamin Moore Galvanized Metal Primer (155).

d. Finish Coats: Two (2) coats of Benjamin Moore Super Spec Oil Semi-Gloss DMT (P24); 1.5 dry mils for each coat (spray, brush or roller applied).

3. System B - Concrete Masonry Units (Satin Alkyd)

a. Surface Preparation: Prepare surfaces in accordance with specifications for masonry and concrete.

b. Prime Coat: Benjamin Moore Moorcraft Super Craft Latex Block Filler (285) or equal, applied as necessary to produce a smooth, dense surface.

c. Finish Coats: Two (2) coats of Benjamin Moore Advance Satin Waterborne Alkyd (0792); 1.5 dry mils for each coat (spray, brush or roller applied).

4. System C - Drywall (Low-Sheen Latex)

a. Surface Preparation: Prepare surfaces in accordance with the specifications for drywall.

b. Prime Coat: Benjamin Moore Ultra Spec Interior Latex Primer (N534); 1 dry mil (spray, brush or roller applied).

c. Finish Coats: Two (2) coats of Benjamin Moore Ultra Spec Interior Latex Flat (N536); 1.5 dry mils for each coat (spray, brush or roller applied).

5. System D - Drywall (Satin Alkyd)

a. Surface Preparation: Prepare surfaces in accordance with the specifications for drywall.

b. Prime Coat: Benjamin Moore Ultra Spec Interior Latex Primer (N534); 1 dry mil (spray, brush or roller applied).

c. Finish Coats: Two (2) coats of Benjamin Moore Advance Satin Waterborne Alkyd (0792); 1.5 dry mils for each coat (spray, brush or roller applied).

6. System E – Wood, PVC and Plywood - Painted Finish (Satin Alkyd):

   a. Surface Preparation: Prepare surfaces in accordance with specifications for wood surfaces.

   b. Primer Coat: Benjamin Moore PS 5800 INSLX Lock Oil Primer/Sealer Undercoater; 1.5 dry mils (spray, brush or roller applied).

   c. Finish Coats: Two (2) coats of Benjamin Moore Advance Satin Waterborne Alkyd (0792); 1.5 dry mils for each coat (spray, brush or roller applied).

7. System F - Concrete Floors (Epoxy):

   a. Surface Preparation: In accordance with finish system manufacturer's instructions, which may include brush blasting concrete floors to provide a dense 2 mil anchor profile. Acid surface etching will also be allowed.

   b. Finish Coat: Benjamin Moore COROTECH 100% Solids Epoxy Floor Coating V430 (2-component system) with slip-resistant silica sand, or manufacturer approved similar product to produce slip-resistant finish under wet foot-traffic conditions.

C. Mechanical and Electrical Work:

Except for manufacturer painted items, paint all exposed mechanical and fire protection piping, valves, fittings, traps, conduit, miscellaneous fittings and boxes, pipe and duct insulation, steel hangers and attachments, floor, ceiling and wall plates (except those which are plated), ducts, diffusers, grilles, supports, clamps, straps, etc., in rooms and spaces designated to be finish painted. Painting systems shall be based on the surface and its environment, as approved by the Resident.

D. Equipment:

In general, switchboards, disconnect switches, motors, light and power panels, etc., will be completely shop finished by the manufacturers. All equipment shall be touched-up by the installer where finish is damaged during installation.

3.11 PAINTING SCHEDULE

SURFACE	SYSTEM
A. Interior	
1. Concrete and Concrete Masonry Unit Walls	B
2. Concrete Floors (including equipment pads)	F

3. Metals

a.	Steel Doors and Steel Frames	A (2)
b.	Exposed Conduit, Light Fixture Pendants, Pipe, etc.	A (2)

4. Gypsum Wallboard

a.	Walls	D
b.	Exposed Ceilings	C

5. Wood and PVC

a.	Standing and Running Trim	E
b.	Shelves	E

B. Exterior

1. Metal

a.	Steel Doors and Frames	A(1)
b.	Bollards	A(1)
c.	Structural Steel for Canopy (Exposed)	A(1)

2. PVC

a.	Trim	E
b.	Soffit	E
c.	Back-priming (fascia backup-panels, trim, etc.)	E (primer only)

C. In general, miscellaneous brackets, angles, plates, etc., shall receive the same finish coats as the items to which they are associated. Surface preparation and prime coats shall be as specified for similar materials in the same space/environment or as otherwise directed by the Engineer.

D. In general, ductwork, piping and conduit running exposed on walls and ceilings (including attachment devices, supports, accessories, etc.) shall receive the same type finish coat as adjacent surfaces. Surface preparation and prime coats shall be as specified for similar materials in the same space/environment or as otherwise directed by the Engineer.

END OF SECTION

SECTION 101423

ROOM-IDENTIFICATION SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction, and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allen Industries Architectural Signage.
b. APCO Graphics, Inc.
c. ASE, Inc.
d. ASI Sign Systems, Inc.
e. Best Sign Systems, Inc.
f. InPro Corporation (IPC).
g. Mohawk Sign Systems.
h. Signature Signs, Inc.

i. Vomar Products, Inc.
j. Welch Signs, LLC

2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic or phenolic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Surface-Applied Graphics: Applied paint.
c. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Bullnosed.
b. Corner Condition in Elevation: Rounded to radius.

4. Mounting: Surface mounted to wall with hook-and-loop tape.
5. Text and Typeface: Accessible raised characters and Braille; typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

B. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls according to the accessibility standard.

C. Mounting Methods:
1. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 102800

TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, supplies, labor and supervision, and performing all operations required to install all toilet accessories as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

1.03 SUBMITTALS

Submit eight (8) copies of manufacturers' product data for approval. Product data shall indicate all materials, dimensions, gauges of steel, assembly, hardware and finishes.

PART 2 - MATERIALS

2.01 TOILET ACCESSORIES

A. All toilet accessories shall be as manufactured by Bobrick Washroom Equipment Inc., Bradley Corp., or ASI.

Catalog numbers listed below are for Bobrick Products.

Mirror	B-290-2436
Sanitary Disposal Unit	B-270
Wall Shelf	B-295 x 16
Soap Dispenser with Shelf	Furnished by MTA, Install by GC
Paper Towel Dispenser	Furnished by MTA, Install by GC
Waste Receptacle	Furnished by MTA, Install by GC
Toilet Roll Holders	Furnished by MTA, Install by GC

B. Grab Bars: Grab bars shall be satin finish stainless steel, 1 1/2 inch diameter, of the lengths shown, with concealed mounting flanges, and mounting flange cover plate with four set screws for securing. Bars shall be equal to Bobrick Products B 5806x18, B 5806x36 & B 5806x42.

C. Obtain all toilet accessories from a single manufacturer.

D. Mop Hanger: Mop hanger shall be 24 inches long, 3 inches wide stainless steel with three (3) rubber tool grips equal to Catalog No. 889-CC as manufactured by Crane Plumbing and Fiat Products, or equal by Florestone or E.L. Mustee & Sons, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

Install accessories where shown on the Drawings, in accordance with the manufacturer's approved instructions.

END OF SECTION

SECTION 104416

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, transportation, labor and supervision, and performing all operations required to install all fire extinguishers and mounting brackets as shown on the Drawings, as specified herein, and as is additionally required to properly complete the work.

1.03 SUBMITTALS

Submit copies of material brochures and installation instructions and details for approval.

1.04 GENERAL

A. Provide fire extinguishers, mounting brackets, and accessories manufactured by the same company.

B. Provide fire extinguishers which are U.L. listed and bear U.L. "Listing Mark" for type, rating and classification of extinguisher indicated. All fire extinguishers shall be rechargeable.

PART 2 - MATERIALS

2.01 PRODUCTS

A. Unless otherwise indicated, the fire extinguishers, brackets and accessories are as manufactured by J. L. Industries. Equivalent models manufactured by Ansul Co. or Walter Kidde and Co. are also acceptable.

B. Fire extinguishers shall be multi-purpose 10 lb. dry chemical for A, B & C fires, complete with an accurate pressure safety gauge, Model Cosmic 10E with Bracket No. MB 846. Refer to the Drawings for locations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install brackets and extinguishers in the locations indicated on the Drawings at mounting heights to comply with applicable regulations of governing authorities.

B. Securely fasten mounting brackets to structure, with proper reinforcement, square and plumb, to comply with manufacturer's approved installation instructions.

C. Check extinguishers for proper charge operations. Remove and replace damaged, defective and undercharged units.

END OF SECTION

SECTION 105113

METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Knocked-down lockers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of metal locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples: For each color specified, in manufacturer's standard size.

D. Samples for Initial Selection: Match Owner’s existing building custom color.

E. Product Schedule: For lockers.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of wood bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 KNOCKED-DOWN TWO-TIER CORRIDOR LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASI Storage Solutions; ASI Group.
   2. Lyon Workspace Products, LLC.
   3. Penco Products, Inc.

B. Doors: One piece; fabricated from 16 gauge nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
   1. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
   2. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
   3. Door Style: Unperforated panel.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

   1. Tops, Bottoms, and Intermediate Dividers: 24-gauge nominal thickness, with single bend at sides.
   2. Backs and Sides: 24-gauge nominal thickness, with full-height, double-flanged connections.
   3. Shelves: 24-gauge nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

   1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
   2. Frame Vents: Fabricate face frames with vents.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
   1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks.

    a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
    b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

G. Door Handle and Latch for Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

I. Hooks: Manufacturer's standard ball-pointed type hooks, aluminum or steel; zinc plated.

J. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet.

1. Closures: Vertical-end type.

K. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

L. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

M. Finish: Baked enamel or powder coat.

1. Exterior Color: As selected from Manufacturer’s 12 minimum standard colors by the Architect.

2. Interior Color: Standard “Decorator Tan”.

N. Size: Lockers shall be 12” W by 18” D by 36” H each; Full Height for double-tier.

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Equipment: Provide each locker with an identification plate and the following equipment:
   1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
   2. Coat Rods: For each compartment of each locker.

D. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.

E. Accessible Lockers: Fabricate as follows:
   1. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Base: Field fabricate wood-framed base. Finish with vinyl cove base in color as selected by the Architect.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

2.5 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.

   1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
   2. Anchor single rows of metal lockers to walls near top and bottom of lockers.

3. Anchor back-to-back metal lockers to floor.

B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers.

a. Attach plates to each locker door in combination lock recessed pull to match Owner's existing building lockers.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
1. Attach filler panels with concealed fasteners.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 113100

RESIDENTIAL APPLIANCES

PART 1 - DESCRIPTION

1.01 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.02 DESCRIPTION

The work in this section consists of furnishing all materials, equipment, supplies, transportation, and performing all operations required to install complete, in-place, kitchen equipment as shown on the drawings, as specified herein and as is additionally required to properly complete the work.

1.03 SHOP DRAWINGS

Submit eight (8) copies of shop drawings showing all details of equipment specified along with installation instructions and operations manuals.

PART 2 - MATERIALS

2.01 KITCHEN EQUIPMENT

A. Provide the following appliances:

1. Refrigerator with Icemaker: General Electric Model no. GTS18GTNRWW

    a. Size: 17.5 cu. ft.
    b. Color: White
    c. IM4D ready (for Icemaker)

2. Microwave Oven: General Electric Model no. JES1460DSWW

    a. Size: 1.4 cu. ft.
    b. Color: White

B. The Contractor shall provide the Authority with a full one year warranty on the kitchen equipment.

PART 3 – INSTALLATION

3.01 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations.

B. Built-In Equipment: Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances area adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper appliance operation.

D. Utilities: Refer to Divisions 22 and 26 for plumbing and electrical requirements.

3.02 ADJUST AND CLEAN

A. Testing: Test each item of equipment to verify proper operation. Make any necessary adjustments to ensure proper operations.

END OF SECTION

SECTION 123216

MANUFACTURED PLASTIC-LAMINATE-FACED CABINETS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Examine Drawings, Contract Conditions all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all Project work.

1.2 SUMMARY

A. This Section includes the following:

1. Plastic-laminate-faced kitchen cabinets.
2. Plastic-laminate countertops.
3. Plastic-laminate worksurfaces and supports.
4. Shelving and supports.

1.3 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

B. Semiexposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semiexposed."

C. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

1.4 SUBMITTALS

A. Product Data: For the following:

1. Cabinets.
2. Plastic-laminate countertops and worksurfaces.
3. Shelving.
4. Cabinet hardware.
5. Shelving hardware.
6. Worksurface supports.

B. Shop Drawings: For cabinets, countertops, worksurfaces, and shelving. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining countertops. Show details for worksurface and shelving supports.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material exposed to view.

D. Product Certificates: Signed by manufacturers of casework certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations for Cabinets: Obtain cabinets through one source from a single manufacturer.

B. Quality Standards: Unless otherwise indicated, comply with the following standards:

1. Cabinets: KCMA A161.1.

a. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install kitchen casework until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where kitchen casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements: Where kitchen casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes if necessary.

D. Field Measurements for Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is

complete. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of kitchen casework.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cabinets: Similar to “Glencoe Square” by Merillat Industries LLC.

2. Plastic Laminate for Countertops:

a. Formica Corp.
b. Laminart.
c. Nevamar Corp.
d. Westinghouse Electric Corp.; Specialty Products Div.
f. Wilsonart: Ralph Wilson Plastics Co.

2.2 COLORS, TEXTURES, AND PATTERNS

A. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range for these characteristics.

2.3 CABINET MATERIALS

A. Exposed Materials: Comply with the following:

1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.

a. Where edges of solid-color plastic-laminate sheets will be visible after fabrication, provide through-color plastic laminate.

B. Semiexposed Materials: Unless otherwise indicated, provide the following:

1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.

2.4 COUNTERTOP MATERIALS

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Grade: HGS.
2. Grade: HGP.
3. Provide through-color plastic laminate.
4. Grade for Backer Sheet: BKL.

2.5 CASEWORK HARDWARE

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, material, size, and finish as selected from manufacturer's standard choices.

B. Hinges: Concealed European-style hinges.

C. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05091.

D. Pulls: Manufacturer’s standard metal wire pulls in brushed satin finish.

2.6 CABINET CONSTRUCTION

A. Face Style: Flush overlay; door and drawer faces cover cabinet body members or face frames with only enough space between faces for operating clearance.

B. Face Frames: Frameless.

C. Door and Drawer Fronts: 1/2-inch-thick particleboard with plastic-laminate faces, backs, and edges. Provide same grade, pattern, color, and texture of plastic laminate for backs and edges as for faces.

D. Exposed Cabinet Ends: Plastic-laminate-faced particleboard.

E. Cabinet Tops and Bottoms: 5/8-inch-thick particleboard or 1/2-inch-thick plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.

F. Back, Top, and Bottom Rails: 3/4-by-2-1/2-inch solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.

G. Wall-Hung Unit Back Panels: 3/16-inch-thick plywood fastened to rear edge of end panels and to top and bottom rails.

H. Base Unit Back Panels: 3/16-inch-thick plywood fastened to rear edge of end panels and to top and bottom rails.

I. Front Frame Drawer Rails: 3/4-by-1-1/4-inch solid wood mortised and fastened into face frame.

J. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

K. Shelves: 3/4-inch-thick laminate clad particleboard or 5/8-inch- thick laminate clad plywood.

L. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.

M. Factory Finishing: To greatest extent possible, finish casework at factory. Defer only final touchup until after installation.

2.7 PLASTIC-LAMINATE COUNTERTOPS AND WORKSURFACES

A. Configuration: Provide post-formed countertops at kitchen casework locations. Provide square edge countertops at work surface locations.

B. Plastic-Laminate Substrate: Particleboard not less than 3/4 inch thick.

1. For countertops at sinks and lavatories, use phenolic-resin particleboard or exterior-grade plywood.

2. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of particleboard laminated to top.

C. Backer Sheet: Provide plastic-laminate backer sheet on underside of countertop substrate.

2.8 SHELVING

A. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: White.

B. Closet and Utility Shelving: Made from the following material, 3/4 inch thick.

1. Melamine-faced particleboard.

C. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel; similar to Knape & Vogt #85 Series Heavy Duty steel vertical standards. Color shall be white.

D. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel; similar to Knape & Vogt #185 Series Heavy Duty full shelf depth bracket. Color shall be white.

2.9 WORKSURFACE SUPPORTS

A. Support Brackets for Surfaces: A & M Hardware, Inc pre-finished support bracket; white; size as required to support 300 lbs. per linear foot of worksurface for the depth indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install casework with no variations in flushness of adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.

B. Install casework without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.

C. Install casework and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.

D. Fasten cabinets to adjacent units and to backing.

E. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

F. Install shelving, shelving supports, worksurfaces, and surface supports in accordance with the manufacturer’s written instructions and as indicated.

3.2 ADJUSTING AND CLEANING

A. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas. Protect finishes from damage and other causes during construction.

END OF SECTION

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg. Co.
2. Zurn Industries, LLC.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 220517

SECTION 220518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and/or rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass with polished, chrome-plated finish.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass with polished, chrome-plated finish.

f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass with rough-brass finish.

g. Bare Piping in Equipment Rooms: One-piece, cast-brass with rough-brass finish.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519

THERMOMETERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.

B. Related Sections:
1. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Trerice, H. O. Co.

2. Standards: ASME B40.200. NSF-61
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Brass and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standards: ASME B40.200, NSF-61(if in direct contact with potable water).
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
11. Scale:
    a. Domestic Cold-Water Piping: 0 to 100 deg F
    b. Domestic Hot-Water Piping: 30 to 240 deg F.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ametek U.S. Gauge.
    b. Ashcroft Inc.
    c. Watts; a Watts Water Technologies company.

2. Standards: ASME B40.100, NSF-61
3. Case: Sealed type; liquid filled, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
12. Scale Range: 0 to 100 psi

2.4 GAGE ATTACHMENTS

A. Snubbers: NSF-61, ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install remote-mounted pressure gages on panel.

H. Install valve and snubber in piping for each pressure gage for fluids.

I. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Where shown on drawings

J. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.
4. Where shown on drawings

3.2 CONNECTIONS

A. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance of thermometers, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 220519

SECTION 220523.12
BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Two-Piece, Brass Ball Valves with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. NIBCO INC.
c. Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. NIBCO INC.
c. Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: Shall be provided with solder-joint ends. Threaded ends shall be provided where equipment or connecting fixtures warrant threaded piping.

B. Pipe NPS 2-1/2 and Larger:

1. Bronze and Brass Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

END OF SECTION 220523.12

SECTION 220523.14
CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

   1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 150, bronze disc with soldered or threaded end connections.

B. Pipe NPS 2-1/2 and Larger: Bronze swing check valves, Class 150, bronze disc with threaded or flanged end connections.

END OF SECTION 220523.14

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized carbon steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. National Pipe Hanger Corporation.
3. Pipe Shields Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel per AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, and metal trapeze pipe hangers for general service applications.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
9. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
11. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Craftmark Pipe Markers.
d. Seton Identification Products.

2. Material and Thickness: aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Craftmark Pipe Markers.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Red.

D. Background Color: White.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Carlton Industries, LP.
4. Craftmark Pipe Markers.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Carlton Industries, LP.
4. Craftmark Pipe Markers.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Craftmark Pipe Markers.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Domestic Water Piping

    a. Background: Safety green.
    b. Letter Colors: White.

2. Sanitary Waste Piping:

   a. Background Color: Safety white.
   b. Letter Color: Black.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Cold Water: Natural.
   b. Hot Water: Natural.

3. Letter Colors:

   a. Cold Water: White.
   b. Hot Water: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
4. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Phenolic:

1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
4. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.

6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight

pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water and Domestic Hot Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 3/4 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:
a. Rigid High impact PVC

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None, if factory jacket is provided else,
2. Aluminum, Smooth: 0.024 inch thick.
3. Stainless Steel, Type 304 orType 316, Smooth 2B Finish: 0.020 inch thick.

D. Piping, Exposed:
1. PVC: 30 mils thick.

END OF SECTION 220719

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Fittings in "Cast-Copper, Solder-Joint Fittings" Paragraph below are available in NPS 1/4 to NPS 12.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts; a Watts Water Technologies company.
b. Wilkins.
c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts; a Watts Water Technologies company.
b. Wilkins.
c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products.
c. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 203- Excavation and Embankment for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, insulate, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Inspect piping for leaks and defects.
c. Leave new domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to a third-party testing agency to ensure safe drinking water has been achieved.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

   1. Shutoff Duty: Use ball for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Temperature-actuated, water mixing valves.
4. Strainers.
5. Hoss bibb.
6. Wall hydrants.
7. Drain valves.
8. Water-hammer arresters.

B. Related Requirements:

1. Section 220519 "Thermometers and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters and Disinfection.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: See Drawings.
6. Pressure Loss at Design Flow Rate: 10 psig for sizes NPS 2 and smaller.
7. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved
8. End Connections: Threaded for NPS 2 and smaller.
9. Configuration: Designed for horizontal, straight-through flow.
10. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Valve Finish: Rough bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated.
3. End Connections: Threaded for NPS 2 and smaller.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch

6. Drain: Factory-installed, hose-end drain valve.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1019 for performance requirements for backflow protection and freeze resistance of self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Hand-wheel.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 1/2 or NPS 3/4.
7. Box: None.
8. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Nozzle and Wall-Plate Finish: Polished nickel bronze.
10. Operating Keys(s): None.
11. Hand-wheel: Metal

B. Vacuum Breaker Wall Hydrants:

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig.
5. Operation: wheel handle.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 1/2 or NPS 3/4.
8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

C. Install Y-pattern strainers for water on supply side of each backflow preventor.

D. Install water-hammer arresters in water piping according to PDI-WH 201.

E. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Thermostatic, water mixing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For solvent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 FITTINGS NOT ALLOWED

A. DOUBLE WYE: The use of a double wye is not acceptable for sanitary drainage.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. Fernco Inc.
c. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. MIFAB, Inc.
   c. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dallas Specialty & Mfg. Co.
        2) Fernco Inc.
        3) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C 1173.
    c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
        2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C 1460.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Dresser, Inc.
3) Jay R. Smith Mfg. Co.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) A.Y. McDonald Mfg. Co.
2) Watts; a Watts Water Technologies company.
3) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Watts; a Watts Water Technologies company.
3) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection Corporation.
2) Grinnell Mechanical Products.
3) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements in Section 203- Excavation and Embankment for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drain pipe. Straight tees, elbows, and crosses may

be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping,"

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install full-port ball valve for piping NPS 2 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.

6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.

END OF SECTION 221316

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 221316 "Sanitary Waste and Vent Piping" for sanitary waste and vent piping inside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
2. Size: Same as connected branch.

3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Threaded.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Polished bronze.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, cover plate with screw.
7. Wall Access: Square, wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Standard: ASME A112.6.3.
2. Pattern: Floor and/or funnel floor drain.
3. Body Material: Gray iron.
4. Seepage Flange: Not required.
5. Anchor Flange: Required.
6. Clamping Device: Not required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Not required.
9. Sediment Bucket: Required
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Nickel bronze.
12. Top Shape: Round.
13. Top Loading Classification: Heavy Duty.
14. Funnel: provide where indicated on drawings.
15. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Trap-seal primer valve drain connection.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch-minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install deep-seal traps on floor drains and other waste outlets, if indicated.

F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

H. Install wood-blocking reinforcement for wall-mounting-type specialties.

I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1) Storage Tank: Three years.
2) Controls and Other Components: Two years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A. O. Smith Corporation.
b. Bradford White Corporation.
c. State Industries.

2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1.
e. Jacket: Steel with enameled finish.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat

input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.

B. Capacity and Characteristics:
   a. See design drawings for capacity.

2. Electrical Characteristics:
   a. See design drawings for electrical data.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base.

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Thermometers and Gages for Plumbing Piping."

G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Thermometers and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Thermometers and Gages for Plumbing Piping."

I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

K. Fill electric, domestic-water heaters with water.

L. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224213.13
COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Toilet seats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, FLOOR - OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, floor outlet, tank type.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America, Inc.
b. Kohler Co.
c. TOTO USA, Inc.

2. Bowl:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Tank
   e. Height: Handicapped/elderly, complying with ICC/ANSI A117.1.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.28 gal. per flush.
   h. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.
4. Flush Valve: None

2.2 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America, Inc.
   b. Kohler Co.
   c. TOTO USA, Inc.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Install toilet seats on water closets.

C. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

D. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13
COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Wheelchair, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America, Inc.
   b. Kohler Co.
   c. Sloan Valve Company.

2. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: Slab or wheelchair.
   c. Nominal Size: Rectangular, 27 by 20 inches.
   d. Faucet-Hole Punching: Three holes, 2-inch centers.
   e. Faucet-Hole Location: Top.
   f. Color: White.
   g. Mounting: For concealed-arm carrier.

3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing or two-handle mixing, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America, Inc.
   b. Kohler Co.
   c. Moen Incorporated.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, concealed.
10. Valve Handle(s): Single lever.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Operation: Compression, manual.
14. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/4.

2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
4. Provide with trap primer overflow connection for the trap primer for the floor drain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16
COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins
2. Sink faucets.
3. Supply fittings.
4. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. FIAT PRODUCTS
    b. Approved alternate.

2. Fixture:

    a. Standard: IAPMO PS 99.
    b. Shape: Square.
    c. Nominal Size: 24 by 24 inches.
    d. Height: 6 inches.
    e. Tiling Flange: Not required.
    f. Rim Guard: Stainless steel, On all top surfaces.
    g. Wall Guard: Stainless Steel, all around
    h. Color: White
    i. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.

2.2 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America, Inc.
    b. Approved alternate.

2. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: Stainless steel, self-rimming.
    c. Number of Compartments: 1.

d. Overall Dimensions: 25”x22”.
e. Material: 20-gauge, stainless steel.
f. Compartment:

1) Dimensions: 8” depth.
2) Drain: 1-1/2”

3. Faucet: Manually operated.

a. Number Required: 1.
b. Mounting: On ledge.

4. Mounting: On counter with sealant.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2
2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: **Class F as a minimum**

I. Code Letter Designation:

1. Motors **15** HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 1**5** HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.

B. Related Sections:

1. Section 230548 "Vibration and Seismic Controls for HVAC"
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer in the State of Maine. Show fabrication and installation details and include calculations for the following, include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturer: Subject to compliance with requirements, provide product by one of the following or equal:

    a. Allied Tube & Conduit.
    b. Flex-Strut Inc.
    c. Unistrut; an Atkore International company.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturer: Subject to compliance with requirements, provide product by one of the following or equal:

    a. Anvil International.
    b. Empire Industries, Inc.
    c. Haydon Corporation.
    d. NIBCO INC.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.04 THERMAL-HANGER SHIELD INSERTS

1. Manufacturer: Subject to compliance with requirements, provide product by one of the following or equal:
2. Carpenter & Paterson, Inc.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.
5. Pipe Shields Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

A. Contractor shall verify suitability of fastener for each application. The following paragraphs are generally suited for lightweight concrete or concrete slabs less than 4 inches thick. Consult with Fastener manufacturer for each application. Manufacturer installation instructions and guidelines shall be strictly adhered to.

B. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

C. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger

and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

    b. NPS 4: 12 inches long and 0.06 inch thick.

    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Clean and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

PART 4 - COMPENSATION

4.01 MEASUREMENT

A. The Work of this Section shall be measured on a Lump Sum Basis as part of Section 230000 – HEATING, VENTILATING AND AIR CONDITIONING. No separate measurement or payment will be made for the Work of this Section.

B. Payment for the work of this Section shall be as described in the SUPPLEMENTAL INSTRUCTIONS TO BIDDERS.

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Elastomeric hangers.
9. Spring hangers.
10. Restraint cables.
11. Seismic-restraint accessories.
12. Mechanical anchor bolts.
13. Adhesive anchor bolts.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring mounts and restrained-air-spring mounts to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mason Industries, Inc.
b. Vibration Isolation.
c. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth Ribbed Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric Insert compound.

a. Surface Pattern: Smooth Ribbed Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mason Industries, Inc.
b. Vibration Isolation.
c. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mason Industries, Inc.
b. Vibration Isolation.
c. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mason Industries, Inc.
    b. Vibration Isolation.
    c. Vibration Mountings & Controls, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable non-adjustable snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.5 RESTRAINED-AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Firestone Industrial Products Company.
    b. Mason Industries, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top plate with threaded mounting holes elastomeric pad.
c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
9. Maximum Natural Frequency: 3 Hz.
10. Operating Pressure Range: 25 to 100 psig.
11. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
12. Tank valves.

2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mason Industries, Inc.
b. Vibration Eliminator Co., Inc.
c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mason Industries, Inc.
b. Vibration Isolation.
c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mason Industries, Inc.
2. Vibration & Seismic Technologies, LLC.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: [ASTM A 603 galvanized] [ASTM A 492 stainless]-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.9 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mason Industries, Inc.
2. TOLCO.
3. Vibration & Seismic Technologies, LLC.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.10 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.11 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.12 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mason Industries, Inc.
2. Vibration Isolation.
3. Vibration Mountings & Controls, Inc.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:
1. Heating Water Piping: White letters on a safety-green background.
2. Refrigerant Piping: Black letters on a safety-white background.

3.5 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Refrigerant: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.
   c. Gas: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
   b. Potable and Other Water: White letters on a safety-green background.

c. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Multizone systems.

2. Balancing Hydronic Piping Systems:
a. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Owner, Construction Manager, and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer of record and Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Engineer of Record for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.11 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.

3.12 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.

8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft.
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.

j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. Gas- Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.

d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.

g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 5 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Construction Manager and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager and Commissioning Authority.
3. Construction Manager and Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713
DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply, return and outdoor air.
2. Indoor, exposed supply, return and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Owens Corning.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Owens Corning.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Owens Corning.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.

c. Foster Brand; H. B. Fuller Construction Products.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Knauf Insulation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

B. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

C. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a

rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Polyguard Products, Inc.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.
    c. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.
    c. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.

b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.

    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Gemco.
        2) Midwest Fasteners, Inc.

    b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Hardcast, Inc.

    b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Gemco.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. C & F Wire.

2.8 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1-inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   2. Factory-insulated flexible ducts.
   3. Factory-insulated plenums and casings.
   4. Flexible connectors.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and3-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

F. Concealed, rectangular, return-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
   3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

G. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:

   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

I. Concealed, supply-air plenum insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

J. Concealed, return-air plenum insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

K. Concealed, outdoor-air plenum insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

L. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

M. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

N. Exposed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

O. Exposed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

P. Exposed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

Q. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

R. Exposed, supply-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

S. Exposed, outdoor-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
   1. Aluminum, Smooth or Corrugated: 0.024 inch thick.

D. Ducts and Plenums, Exposed:
   1. Aluminum, Smooth or Corrugated: 0.024 inch thick.

END OF SECTION 230713

SECTION 230923
AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of all labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the automatic temperature control system indicated. The system shall be an electric/electronic (not DDC) system to provide the sequences as described in these specifications. The ATC system shall be complete including required components including, low voltage and line voltage wiring. The system shall function as a completely independent system and shall include a wall mounted interface panel for adjusting system settings. The system shall not require a computer terminal or laptop be present to adjust any systems settings.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the automatic control system manufacturer for both installation and maintenance of units required for this project.

B. Available Control Systems Manufacturers:
   1. BASIX
   2. Honeywell
   3. IB Controls
   4. JCI
   5. Maine Controls
   6. Siemens
   7. Trane

C. Control Systems shall be engineered, programmed and supported completely by representative located within 75 miles of project site.

1.4 SUBMITTALS

A. Drawings:
   1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
   2. Drawings shall be submitted in the following sizes: 11”x17” (ANSI B).

B. System Documentation: Include the following information in the submittal package:
   1. Written description of sequence of operation.
   2. Schedule of dampers including size, leakage, and flow characteristics.
   3. Schedule of valves including leakage and flow characteristics.
   4. Trunk cable schematic showing programmable control unit and input device.
   5. All input/output object listings and an alarm point summary listing.
   6. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   7. Manufacturer’s instructions and drawings for installation, maintenance, and operation of all purchased items.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 – Contract Closeout: Closeout procedures.

B. Submit final copies of the shop drawings outlined in paragraph 1.4. These submittals shall reflect field modifications.

1.6 WARRANTY

A. All components, system software, and parts supplied by the BAS contractor shall be guaranteed against defects in material and workmanship for a period of one year from acceptance date. During this warranty period the BAS contractor shall furnish labor to repair, reprogram, or replace components at no charge.

B. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer software archived software disks.

C. The contractor shall provide warranty service within 24 hours of the Owner’s request.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

A. In general, relays, transformers, or other control devices (not including room thermostats or duct-mounted instruments) shall be grouped and mounted in a factory-built cabinet enclosure.

2.2 SEQUENCES OF CONTROL

A. Provide and install electronic/electric components to enable the mechanical system to operate in the following sequences:

1. Energy Recovery Ventilator ERV-1 shall run continuously. System to run on the internal controls provided with the ERV unit
2. Electric Wall Heaters EWH-1&2 to operate off the built-in thermostat in the units.
3. Electric Baseboard EBB-1,2,3 to be supplied with a built-in relay. Energize the relays on a 12v signal from the external heat relay supplied with IU-1.
4. Heat Pumps systems OU-1/IU-1 and OU-2/IU-2 to operate off the thermostats supplied by the equipment manufacturer. Install, wire and test the entire heat pump systems.
5. For the Cabinet Unit Heaters in the Toll Booths provide and install low voltage control and a remote thermostat provided with the Unit Heater.
6. The Spilt System Heat Pumps in the Toll Booths provide and install low voltage control wiring for the remote thermostat provided with the Manufacturer.
7. The packaged wall-mounted heat pump in the Utility Building shall operate off the thermostat supplied by the equipment manufacturer. Install, wire and test the entire heat pump systems.
8. For the exhaust fan in the Utility Building provide and install low voltage control and a remote thermostat. Fan to operate if heat pump cannot keep up with cooling demand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

B. Verify that the automatic temperature control and system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide wiring, and conduit to connect the ATC components for an operational ATC system. Wiring and installation shall conform to NEPA 70 and requirements of Division 26.

E. Identification: Label or code each field wire at each end. Permanently label or code each point of field terminal strips to show the instrument or item served. Color-coded cable with annotated cable diagrams may be used to accomplish cable identification.

3.3 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.4 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Architect, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner in the operation and maintenance of each automatic space temperature control system. The period of instruction shall be for not less than two 8-hour working days and shall include videotape demonstration of controllers.

3.5 FIELD INSPECTION AND TESTS

A. Tests shall be performed or supervised by employees of the ATC system or manufacturer of the ATC system, or by an authorized representative of the ATC manufacturer. Give Architect 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Architect witnesses tests, such tests shall be subject to approval. If the Architect does not witness tests, provide performance certification.

B. Plan for Inspections and Tests: Furnish a written inspections and tests plan at least 60 days prior to the field acceptance test date. This plan shall be developed by the manufacturer of the ATC system. The plan shall delineate the inspections and testing procedures required for the ATC system to demonstrate compliance with the requirements specified. Additionally, the test plan shall indicate how ATC system is to be tested, what variables will be monitored during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of HVAC system and ATC system in each seasonal condition will be simulated.

C. Field Acceptance Testing: Upon completion of 72 hours of continuous H&V and ATC systems operation and before final acceptance of work, test the automatic temperature control systems in service with the heating, ventilating and air conditioning systems to demonstrate compliance with contract requirements. Test controls through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning automatic space temperature control equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

3.6 FIRESTOPPING

A. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

END OF SECTION 230923

SECTION 231123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.

2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
6. Mechanical Couplings:
    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        1) Dresser Piping Specialties; Division of Dresser, Inc.
        2) Smith-Blair, Inc.
    b. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Stainless-steel bolts, washers, and nuts.
    e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.

2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.

   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.

   c. Aboveground Portion: PE transition fitting.

   d. Outlet shall be threaded or flanged or suitable for welded connection.

   e. Tracer wire connection.

   f. Ultraviolet shield.

   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.

   b. Outlet shall be threaded or flanged or suitable for welded connection.

   c. Bridging sleeve over mechanical coupling.

   d. Factory-connected anode.

   e. Tracer wire connection.

   f. Ultraviolet shield.

   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dresser Piping Specialties; Division of Dresser, Inc.

      2) Smith-Blair, Inc.

   b. Stainless-steel flanges and tube with epoxy finish.

   c. Buna-nitrile seals.

d. Stainless-steel bolts, washers, and nuts.

e. Factory-installed anode for steel-body couplings installed underground.

C. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
2. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
4. Striker Plates: Steel, designed to protect tubing from penetrations.
5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig (34.5 kPa).

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig.

B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lee Brass Company.

b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.

3. Plug: Bronze.

4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Operator: Square head or lug type with tamperproof feature where indicated.

6. Pressure Class: 125 psig.

7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. McDonald, A. Y. Mfg. Co.

b. Mueller Co.; Gas Products Div.

c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.

8. Pressure Class: 125 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Flowserve.
    b. Homestead Valve; a division of Olson Technologies, Inc.
    c. McDonald, A. Y. Mfg. Co.
    d. Milliken Valve Company.
    e. Mueller Co.; Gas Products Div.
    f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. PE Ball Valves: Comply with ASME B16.40.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Kerotest Manufacturing Corp.
    b. Lyall, R. W. & Company, Inc.
    c. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig.
8. Operating Temperature: Minus 20 to plus 140 deg F.
9. Operator: Nut or flat head for key operation.

10. Include plastic valve extension.

11. Include tamperproof locking feature for valves where indicated on Drawings.

I. Valve Boxes:

1. Cast-iron, two-section box.

2. Top section with cover with "GAS" lettering.

3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.

4. Adjustable cast-iron extensions of length required for depth of bury.

5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.

2. Steel jacket and corrosion-resistant components.

3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Actars.

b. American Meter Company.

c. Eclipse Combustion, Inc.

d. Fisher Control Valves and Regulators; Division of Emerson Process Management.

e. Invensys.

f. Maxitrol Company.

g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 25 psi.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Eaton.
   b. Maxitrol Company.
   c. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig
10. Maximum Outlet pressure: 0.5 psig (14” w.c.)

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.

f. McDonald, A. Y. Mfg. Co.

g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

h. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.

b. Pressure Rating: 125 psig minimum at 180 deg F.

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

d. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.

b. Factory-fabricated, bolted, companion-flange assembly.

c. Pressure Rating: 125 psig minimum at 180 deg F.

d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.7 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the New York State Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the New York State Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

E. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

A. Comply with the Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator.

W. Install sleeves for piping penetrations of walls, ceilings, and floors.

X. Install sleeve seals for piping penetrations of concrete walls and slabs.

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.

2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.

2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.

2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.

2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING

A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Exterior alkyd enamel matching topcoat.

c. Topcoat: Exterior alkyd enamel semigloss.

d. Color: OSHA Yellow.

B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Quick-drying alkyd metal primer.

b. Intermediate Coat: Interior latex matching topcoat.

c. Topcoat: Interior latex semigloss.

d. Color: OSHA Yellow.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Quick-drying alkyd metal primer.

b. Intermediate Coat: Interior alkyd matching topcoat.

c. Topcoat: Interior alkyd semigloss.

d. Color: OSHA Yellow.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the New York State Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with steel welding fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 OUTDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG

A. Aboveground Piping: Maximum operating pressure more than 5 psig.

B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.

C. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with steel welding fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.16 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:

1. PE valves.

2. NPS 2 and Smaller: Bronze plug valves.

3. NPS 2-1/2 and Larger: Cast-iron, nonlubricated plug valves.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

2. Bronze plug valve.

3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

SECTION 231126
FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Storage containers.
7. Transport truck unloading facility specialties.
8. Pumps.
9. Vaporizers.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. For Piping Containing Only Vapor:

   a. Piping and Valves: 125 psig unless otherwise indicated.

2. For Piping Containing Liquid:

   a. Piping between Shutoff Valves: 350 psig unless otherwise indicated.

B. LPG System Pressure within Buildings: One pressure range. 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for LPG piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Seismic Performance: Vaporizers and storage container supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility LPG piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Submit certification that vaporizer, storage container supports, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Welding certificates.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedules 40 and 80, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. PE Pipe: ASTM D2513, SDR 11.

1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B with corrosion-protective coating covering.
    c. Aboveground Portion: PE transition fitting.
    d. Outlet shall be threaded suitable for welded connection.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded suitable for welded connection.
    c. Bridging sleeve over mechanical coupling.
    d. Factory-connected anode.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

C. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
2. Coating: PE with flame retardant.

    a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

        1) Flame-Spread Index: 25 or less.
        2) Smoke-Developed Index: 50 or less.

3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
4. Striker Plates: Steel, designed to protect tubing from penetrations.
5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig (34.5 kPa).

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for LPG.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with ASME B16.33 and UL 842.

1. CWP Rating: 250 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Socket ends for brazed joints.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing by CSA or agency acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Valves 1-1/4 inch and larger shall be suitable for LPG service, with "WOG" indicated on valve body.

C. General Requirements for Metallic Valves, NPS 2 and Smaller for Vapor Service: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inch to NPS 2 shall have initials "WOG" permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Flow Controls; Conbraco Industries, Inc.
    c. BrassCraft Manufacturing Co.; a Masco company.

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for LPG service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage, second stage and suitable for LPG.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

    a. Eclipse Innovative Thermal Technologies.
    b. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
    c. Maxitrol Company.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 10 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Eaton.
    b. Maxitrol Company.
    c. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 10 psig
10. Maximum Outlet pressure: 0.5 psig (14” w.c.)

2.6 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. A.Y. McDonald Mfg. Co.
    b. WATTS.
    c. Wilkins.

2. Standard: ASSE 1079.
3. Pressure Rating: 250 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 STORAGE CONTAINERS

A. Description: Factory fabricated, complying with requirements in NFPA 58 and ASME Boiler and Pressure Vessel Code and bearing the ASME label. Tanks shall be rated for 250-psig minimum working pressure.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Welding & Tank.
    b. Trinity Industries, Inc.
    c. United Industries Group, Inc.

2. Liquid outlet and vapor inlet and outlet connections shall have shutoff valves with excess-flow safety shutoff valves and bypass and back-pressure check valves with smaller than 0.039-inch drill-size hole to equalize pressure. Liquid-fill connection shall have backflow check valve.

    a. Connections: Color-code and tag valves to indicate type.

        1) Liquid fill and outlet, red.
        2) Vapor inlet and outlet, yellow.

3. Level gage shall indicate current level of liquid in the container. Gages shall also indicate storage container contents; e.g., "Butane," "50-50 LPG Mix," or "Propane."
4. Pressure relief valves, type and number as required by NFPA 58, connected to vapor space and having discharge piping same size as relief-valve outlet and long enough to extend at least 84 inches directly overhead. Identify relief valves as follows:

    a. Discharge pressure in psig.
    b. Rate of discharge for standard air in cfm.
    c. Manufacturer's name.
    d. Catalog or model number.

5. Container pressure gage.
6. For outdoor installation, exposed metal surfaces mechanically cleaned, primed, and painted for resistance to corrosion.
7. Ladders for access to valves more than 72 inches aboveground.
8. Stainless-Steel Nameplate: Attach to aboveground storage container or to adjacent structure for underground storage container.

    a. Name and address of supplier or trade name of container.
    b. Water capacity in gallons and liters.
    c. Design pressure in psig (kPa).
    d. Statement, "This container shall not contain a product having a vapor pressure in excess of 125 psig
    e. Outside surface area in sq. ft. (sq. m).
    f. Year of manufacture.
    g. Shell thickness in inches (mm).
    h. Overall length in feet (m).
    i. OD in feet (m).
    j. Manufacturer's serial number.
    k. ASME Code label.

9. Felt support pads and two concrete or painted-steel saddles per storage container. Corrosion protection required at container-to-felt contact.
10. Tie straps for each saddle.

2.8 VAPORIZERS

A. Description: Factory-fabricated, -assembled, and -tested vaporizer with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket, flue-gas vent, liquid fuel supply and vapor connections, and controls. Assembly shall be FMG labeled and comply with NFPA 58 and NFPA 70.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Algas-SDI.
    b. Ely Energy, Inc.
    c. Ransome Manufacturing; a division of Meeder Equipment Company.

B. Fabricate base and attachment to vaporizers with reinforcement strong enough to resist vaporizer movement during a seismic event when steel base is anchored to a concrete base.

C. Casing:

1. Mineral-fiber insulation, a minimum of 2 inches thick, surrounding the heat exchanger.
2. Integral one-piece skid with forklift access holes.
3. Lifting lugs on top of vaporizer.
4. Flue rain cap and bird screen.
5. Sheet metal jacket with screw-fastened closures and baked-enamel protective finish.
6. Mounting base to secure boiler to concrete base.

7. Control Compartment Enclosure: NEMA 250, Type 4, enclosure housing control panels for LPG-fired vaporizers. Explosion-proof control compartment construction required for electric vaporizers.

D. LPG Liquid and Vapor Circuit Specialties:

1. Y-type strainer with drain valve at inlet.
2. Vaporizer coil safety pressure relief valve.
3. Vaporizer coil blowdown valve.
4. Vapor outlet isolation valve.
5. Pressure gages, a minimum of 2-1/2 inches in diameter, at liquid inlet and vapor discharge. Gages shall have operating-temperature ranges so normal operating range is at approximately 50 percent of full range.

E. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor and control set points and display vaporizer status and alarms.

F. Capacities and Characteristics:

1. Heating Fuel: Propane.
2. Vaporization Heat Exchanger:

a. Minimum Working-Pressure Rating: 250 psig.
b. Test Pressure: 375 psig.

3. LPG Vaporization Rate: as scheduled on drawings
4. Entering-LPG Temperature: Minus 30 deg F.
5. Leaving-LPG Temperature: 80 deg F.
6. Discharge-LPG Pressure: 90 psig.

2.9 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 203- Excavation and Embankment for excavating, trenching, and backfilling.

3.2 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 58 and NFPA 54 requirements for installation and purging of LPG piping.

B. Install underground, LPG piping buried at least 36 inches below finished grade. Comply with requirements in Section 203- Excavation and Embankment for excavating, trenching, and backfilling.

1. If LPG piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, LPG piping according to ASTM D2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of LPG piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install LPG piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

S. Do not use LPG piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator.

V. Install sleeves for piping penetrations of walls, ceilings, and floors.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full ID of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers, and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping, with maximum spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Install LPG piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliances and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 STORAGE CONTAINER INSTALLATION

A. Fill storage container to at least 80 percent capacity with propane.

B. Install piping connections with swing joints or flexible connectors to allow for storage container settlement and for thermal expansion and contraction.

C. Ground containers according to NFPA 780. Grounding is specified in Section 264113 "Lightning Protection for Structures."

D. Set storage containers in felt pads on concrete or steel saddles. Install corrosion protection at container-to-felt contact.

E. Install tie-downs over storage containers on saddles with proper tension.

F. Set concrete saddles on dowels set in concrete base. Anchor steel saddles to concrete base.

3.9 VAPORIZER INSTALLATION

A. Install vaporizer with access space for periodic maintenance.

B. Set vaporizers on and anchor to concrete base.

C. Connect liquid line from pump set, and vapor supply to distribution piping.

D. Install backup connection from vapor space of container to inlet of pressure-regulating valve at vaporizer discharge to bypass the vaporizer during maintenance. Install shutoff valves to change source from vaporizer to storage container.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 FIELD QUALITY CONTROL

A. Test, inspect, and purge LPG according to NFPA 58 and NFPA 54 and requirements of authorities having jurisdiction.

B. LPG piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

A. Underground LPG liquid piping shall be the following:

1. Schedule 40 steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground LPG liquid piping shall be the following:

1. NPS 2 and Smaller: Schedule 80 steel pipe, malleable-iron threaded fittings and threaded and seal welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Underground LPG vapor piping shall be the following:

1. PE pipe and fittings joined by heat-fusion; service-line risers with tracer wire terminated in an accessible location.

D. Aboveground LPG vapor piping shall be one of the following:

1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
2. Schedule 40, steel pipe with wrought-steel fittings and welded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, piping 2” and smaller shall be the following:
1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Aboveground Liquid Piping:

1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe NPS 2 and smaller at service meter shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231126

SECTION 233113
METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following or equal:

    a. Ductmate Industries, Inc.
    b. Lindab Inc.
    c. McGill AirFlow LLC.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct

construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following or equal:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. Rubatex International, LLC.

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following or equal:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. Unistrut; an Atkore International company.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment

to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized or ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099123 "Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
e. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Heat Pumps:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg or 3-inch wg see ESP on drawings.
b. Minimum SMACNA Seal Class: A or B (2 and 3 inch respectively).
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 24.

C. Return Ducts:

1. Ducts Connected to Heat Pumps:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg or 3-inch wg see ESP on drawings.
b. Minimum SMACNA Seal Class: A or B (2 and 3 inch respectively).
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 24.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 24.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg or 3-inch wg see ESP on drawings.
b. Minimum SMACNA Seal Class: A or B (2 and 3 inch respectively).
c. SMACNA Leakage Class for Rectangular: 24.

d. SMACNA Leakage Class for Round: 24.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

G. Liner:

1. Supply Air Ducts: Flexible elastomeric, 1 inch thick.
2. Return Air Ducts: Flexible elastomeric, 1 inch thick.
3. Exhaust Air Ducts: Flexible elastomeric, 1 inch thick.
4. Supply Fan Plenums: Flexible elastomeric, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the work of this Section.

1.02 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Counter-balanced backdraft damper.
5. Flange connectors.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.03 RELATED WORK

A. Section 233113 “Metal Ducts”

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.

d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Nailor Industries Inc.
    b. Ruskin Company.
    c. Vent Products Co., Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Nailor Industries Inc.
b. Ruskin Company.
c. Vent Products Co., Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGill AirFlow LLC.
b. Nailor Industries Inc.
c. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:

a. Hat, U or Angle shaped.
b. 0.094-inch-thick, galvanized sheet steel.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch thick.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McGill AirFlow LLC.
    b. Nailor Industries Inc.
    c. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat, U or Angle-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered stainless steel or aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.04 CONTROL DAMPERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Greenheck Fan Corporation.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Ruskin Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat U or Angle shaped.
2. 0.094-inch-thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel- and opposed-blade design. See drawings. For outdoor air shut off dampers shall be parallel blade. For modulating control/two position service, blades shall be opposed type.
3. Galvanized-steel or Aluminum.
4. 0.064 inch thick single skin or 0.0747-inch-thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.05 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch or 0.39 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Heat-Responsive Device: Resettable or replaceable link and switch package, factory installed, 165 deg F rated.

2.06 COUNTER-BALANCED BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck.
2. Nailor.
3. Vent Products.

B. Description: Frame shall be extruded aluminum channel. Blades shall be galvanized sheet steel with extruded vinyl blade edge seals mechanically locked into blade edge. Adhesive or clip on type seals shall be unacceptable. Blades shall include field adjustable, zinc plated steel counter balance weights to allow pressure relief between 0.01 and 0.05 inches w.g. Bearings shall be dustproof ball type for low pressure operation. Linkage shall be 1/2-inch-wide tie-bar connected to Type 316 stainless steel pivot pins. Dampers shall be designed for maximum 3500 fpm spot velocities and minimum 4 inches w.g. back pressure.

2.07 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Hardcast, Inc.
3. Ward Industries, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.08 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.09 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ruskin Inc.
2. United Enertech Inc.

B. Description: Electronic Zone Pulse volumetric control damper which interfaces with a hand-held damper motor control. The handheld device is equipped with a 9-volt power supply that operates the damper motor via an RJ11 cable that terminates at the diffuser/register/grille.

C. Cable: none

D. Mounting: Terminal device mounted. See manufacturer’s literature for installation instructions.

E. Damper
1. Frame shall be 20ga galvanized steel, 6”
2. Blade shall be equal in gage to frame and like materials
3. Axles shall be minimum 3/8” square shaft
4. Bearings shall be molded Lexan or equal
5. Maximum static pressure shall be 2”
6. Velocity shall not exceed 2000 fpm
7. Actuator shall be gear drive, fail in place motor
8. Power requirements
    a. 9 Volt DC, Powered through handheld remote control. Provide a minimum of (4) four for project

2.10 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches Continuous and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches Continuous and two compression latches with outside and inside handles.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.

2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Flex-Tek Group.
3. McGill AirFlow LLC.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Louver face diffusers.

B. Related Sections:

   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Nailor Industries Inc.
    c. Price Industries.
    d. Titus.

2. Devices shall be specifically designed for constant-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Plaque.
7. Mounting: Surface or T-bar.
8. Pattern: Adjustable.
9. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

B. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Nailor Industries Inc.
    c. Price Industries.
    d. Titus.

2. Devices shall be specifically designed for constant-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white.
5. Face Size:
6. Mounting: Surface or T-bar.
7. Pattern: Adjustable core style.
8. Accessories:

a. Square to round neck adaptor.
b. Throw reducing vanes.
c. Equalizing grid.
d. Plaster ring.
e. Safety chain.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 237213
AIR-TO-AIR HEAT RECOVERY UNITS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Energy recovery ventilator.

B. Related Sections:

1. Section 230548 - Mechanical Sound, Vibration, and Seismic Control: Product requirements for resilient mountings and snubbers for fans for placement by this section.
2. Section 230713 - Duct Insulation: Product requirements for power ventilators for placement by this section.
3. Section 233100 – Metal Ducts: Product requirements for hangers for placement by this section.
4. Section 233300 – Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. American Refrigeration Institute:

1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.

1.3 SUBMITTALS

A. 50-18 of the General Provisions - Submittal Procedures: Submittal procedures.

B. Section 013300 - Submittal Procedures: Submittal procedures.

C. Shop Drawings: Indicate size and configuration of assembly, mountings, weights, ductwork and accessory connections.

D. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, energy recovery wheel performance data, electrical characteristics and connection requirements.

E. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

F. Enthalpy plate performance data for both summer and winter operation.

G. Motor ratings and unit electrical characteristics.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210, and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

E. Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer.

F. For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.

G. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two (2) years from the date of installation.

H. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.

I. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer’s published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI certified will not be accepted. OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.

J. Every unit to be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Enternal Control Circuits Test, Unit Amperage Test

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Product storage and handling requirements.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 WARRANTY

A. Furnish two-year manufacturer's warranty on all parts not including the enthalpy core.

B. Furnish ten-year manufacturer's warranty on energy transfer core performance.

1.9 EXTRA MATERIALS

A. Furnish two sets of belts for each fan.

B. Furnish two sets of filters for each ERV.

PART 2 – PRODUCTS

2.1 ENERGY RECOVERY VENTILATOR

A. Available Manufacturers:

1. RenewAire, Model as scheduled.
2. Approved Equal.

B. Performance

1. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
2. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. Unit shall be capable of operating in both winter and summer conditions without generating condensate. No condensate drains will be required.
3. Continuous Ventilation: Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
4. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.

C. Cabinet:

1. Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
2. Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. [Painted components as supplied by the factory shall have polyester urethane paint on 20-gauge G90 galvanized steel.]
3. Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.
4. Unit shall have factory-installed duct flanges on all duct openings.
5. Cabinet Insulation: Unit walls and doors shall be insulated with 1 inch, 4-pound density, foil/scrim faced, high density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft2-°F/BTU).
6. Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten-year warranty. Performance criteria are to be as specified in AHRI Standard 1060.
7. Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the [non-fused][fused] disconnect.
8. Motorized Isolation Dampers: Exhaust Air and outside Air motorized dampers shall be factory installed.

D. MOTORS

1. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and be shall be supplied with factory installed motor starters.
2. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.

E. Filter: 2-inch-thick MERV-8 pleated type located in both outdoor air and exhaust air streams.

F. Accessories:

1. Provide unit and duct connection orientation per Drawings.
2. Insulated, motorized dampers factory installed and wired in supply and exhaust air streams.

G. Controls: Furnish unit with the following:

1. Manufacturer's Unit Controller as scheduled
2. Provide factory installed filter monitors for each airstream.

H. Performance: As scheduled on Drawings

I. Electrical Characteristics and Components: As scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed and dimensions are as listed by manufacturer.

3.2 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Provide spring type vibration rails or curb to match the specific unit corner weights.

C. Provide sheaves required for final air balance.

3.3 FIELD SERVICES

A. Furnish field services for minimum of one day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

A. Vacuum clean inside of ERV housing.

3.5 DEMONSTRATION

A. Demonstrate ERV operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

A. Do not operate ERV units until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 238100
HEAT PUMPS AND AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components and outdoor, wall-mounted packaged heat pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.

b. For Parts: Five year(s) from date of Substantial Completion.

c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mitsubishi Electric & Electronics USA, Inc.
2. LG Electronics U.S.A, Inc
3. YORK; a Johnson Controls company.

2.2 SPLIT DUCTLESS HEAT PUMP SYSTEM

A. Provide and install variable refrigerant flow, split system, central heat pump systems where indicated on drawings. All components and controls must be of the same manufacturer and intended to function together as a unified system. Capacities shall be as scheduled on sheet M2 Installing contractor must be certified by the equipment manufacturer to properly install the system as specified. Evidence of certification must be included with shop drawing submittals.

B. The systems (outdoor units and air handling units) and equipment described herein are based on a Mitsubishi City-Multi system consisting of PKA and PCA series indoor (airhandling) units, PUZ inverter driven outdoor (Compressor/Condenser) unit and M-NET DDC (Direct Digital Controls).

C. The outdoor Compressor/Condenser unit shall be horizontal air flow, 208/230 volt, single phase. Equivalent equipment meeting the features and performance requirements of this equipment will be considered.

D. Units shall be listed by Electrical Laboratories (ETL) and bear the ETL label. All wiring shall be in accordance with the National Electrical Code (N.E.C.). Units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

F. Provide a full diagrammatic drawing of the system showing all components (including equipment tags), refrigerant piping (including lengths and sizes) and control wiring with the shop drawings.

G. Outdoor (Compressor/Condenser) Units

1. The outdoor units shall be intended specifically for use with other system components. They shall have a powder coated finish and be completely factory assembled, piped and wired. Units shall be run tested at the factory.
2. The outdoor units shall be equipped with circuit boards that interface to the Mitsubishi M-NET control system and shall perform all functions necessary for operation.
3. Unit electrical power shall be 208/230 volts, 1-phase, 60 hertz and shall be capable of satisfactory operation within voltage limits of 187-228 volts.

H. Air Handling Units

1. Units shall be high-performance indoor fan coils for wall mounted units and for ceiling suspended units and shall have a modulating linear expansion device. Units shall support individual control using M-NET DDC controllers.
2. Units shall be factory assembled, wired and run tested. Contained within each unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. Units shall have a self-diagnostic function and an auto restart function. Air handling units and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
3. Coils
    a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
    b. The tubing shall have inner grooves for high efficiency heat exchange.
    c. All tube joints shall be brazed with phos-copper or silver alloy.
    d. The coils shall be pressure tested at the factory.
4. A condensate pan and drain shall be provided under the coil.
5. Each unit shall include a condensate lift mechanism that will be able to raise drain water not less than 12 inches above the condensate pan.
6. Both refrigerant lines to the indoor units shall be insulated.

I. Electrical

1. Refer to Drawings

J. Controls:

1. Air handling units shall cycle in response to their own electronic wall mounted thermostats. Controls shall be a product of this manufacturer and installed by the ATC Contractor.
2. In the dehumidification mode the air handler fans shall cycle on demand for cooling and signal the outdoor unit to activate.

K. Warranty

1. All units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of Substantial Completion. In addition, the compressors shall have a manufacturer's limited warranty for a period of six (6) years from date of Substantial Completion.
2. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty shall not include labor.

L. Options to include

1. 18" High Equipment Stands or Wall Mount Stands as noted on Drawings.
2. Side and End Snow & Hail Guards.
3. Low Ambient Kit: Permits operation down to -10 deg F.
4. Sea Coast Protection

2.3 ROOF-MOUNTED SPLIT SYSTEM HEAT PUMP (In Each Toll Booth)

A. Indoor Unit to be Mitsubishi or reviewed equal Ceiling-recessed cassette (24"x24") ductless heat pump

B. Wide airflow pattern for excellent air distribution Built-in drain condensate lift mechanism Multiple control options available:

C. Third-party interface options Long-life air filter included

D. Outdoor Unit to be Mitsubishi SUZ=KA15NAA or reviewed equal. Variable speed INVERTER-driven compressor

E. Innovative Joint Lap DC Motor leads to high efficiency and reliability Pulse Amplitude Modulation technology

F. High-performance grooved piping for increased heat exchange efficiency

G. Options to be included

1. Wired MA wall-mounted controller
2. 12" High Mounting Stand
3. Refrigerant Line Set.

2.4 PACKAGED OUTDOOR WALL-MOUNTED HEAT PUMP (At Utility Building)

A. Description: Factory-assembled and -tested, self-contained, packaged, terminal heat pump with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis and circuit breaker.

1. Technicoat anti-corrosive epoxy-phenolic coating factory applied on all coils and inner and outer cabinet surfaces.

B. Bard WH Series or reviewed equal.

C. Scroll compressors with liquid line filter-drier.

D. Single stage heat pump cooling and heating.

E. Mechanical Dehumdification: Three-way valve, reheat coil, and electronic expansion valve (EEV). The dehumidification circuit incorporates an independent heat exchanger coil in the supply air stream. This coil reheats the supply air after it passes over the cooling coil without requiring the electric resistance heater to be used for reheat purposes.

F. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

G. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation.

H. Refer to Schedule and Drawings for additional information, including capacities, characteristics, and accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all units level and plumb.

B. Install all equipment in conformance with manufacturer's recommendations.

C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

D. Install wall sleeves in finished wall assembly; seal and weatherproof.

E. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on manufacturer’s stand.
3. Install wall-mounted, compressor-condenser components on manufacturer’s wall-mounting rack.
4. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238200
CONVECTION HEATING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gas-fired unit heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of heater.

1. Include rated capacities, operating characteristics, and accessories.
2. Include plans, elevations, sections, and details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Wiring Diagrams: Power, signal, and control wiring.

B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment details.

1. Prepare by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired unit heaters, as well as procedures and diagrams.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which equipment will be attached.

2. Items penetrating roof and the following:

    a. Vent and gas piping rough-ins and connections.

B. Seismic Qualification Certificates: For gas-fired unit heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gas-fired unit heaters to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GAS-FIRED UNIT HEATERS

A. MANUFACTURERS
1. Rinnai
2. Approved equal.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Capacities and Characteristics:

1. Refer to Schedule on Drawings.

D. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.

E. Gas Type: Design burner for natural gas or LP gas (propane) having characteristics same as those of gas available at Project site.

F. Type of Venting: direct vent.

G. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.

1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
2. Discharge Louvers: Independently adjustable, horizontal blades.

H. Accessories:

1. Four-point suspension kit.
2. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac motor.
3. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.

I. Heat Exchanger: Stainless steel.

J. Burner Material: Stainless steel.

K. Centrifugal Unit Fan

L. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Enclosure Materials: Rolled steel.
3. Unusual Service Conditions:

a. Ambient Temperature: 40 deg F.
b. High humidity.

4. Efficiency: Premium efficient.

M. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

1. Gas Control Valve: Single stage
2. Ignition: Electronically controlled electric spark with flame sensor.
3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.

4. Vent Flow Verification: Flame rollout switch.
5. Control transformer.
6. High Limit: Thermal switch or fuse to stop burner.
7. Wall-Mounted Thermostat:

    a. Single stage.
    b. Fan on-off-automatic switch.
    c. 24-V ac.
    d. 60 to 80 deg F operating range.

N. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.2 ELECTRIC BASEBOARD HEAT

A. Furnish and install where shown on the drawings Architectural Style Electric Baseboard Heat. Markel 3700 Series or approved equal.

B. Baseboard to have the Standard features:

C. White powder coated finish

D. 12 Gauge heavy duty extruded Aluminum housing

E. Stainless steel heating element and Aluminum fins.

F. 4 Automatic thermal linear limit along the entire heated length.

G. Junction Boxes on both ends.

H. Wire guards along entire outlet area.
1. Include the following optional features on all baseboard.
2. Factory Disconnect mounted in baseboard cover.

I. Factory low-voltage relay in each unit.

2.3 ELECTRIC WALL HEATERS

A. Furnish and install where shown on the drawings an Electric Heavy-Duty Wall Heaters. Markel Series 3420 or approved equal.

B. Wall Heaters to have the Standard features:

C. Power coated bar stock steel tamper proof grille

D. Extruded Aluminum frame and 16 GA housing.

E. In-Built double pole tamper-proof thermostat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54 / NFPA 58, applicable local codes and regulations, and manufacturer's written instructions.

B. Install electric wall heaters to comply with NFPA 90A. Install level and plumb. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.2 EQUIPMENT MOUNTING

A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.

1. Spring hangers and seismic restraints are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
2. Threaded Rods, Spring Hangers, and Building Attachments: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment".
3. Threaded Rods, Spring Hangers, Building Attachments, and Seismic Restraints: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
4. Anchor the unit to resist code-required horizontal acceleration.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.

C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

D. Vent Connections: Comply with manufacturer’s recommendations.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 238200

SECTION 260501

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide required electrical work associated with electrical systems for a new administration building(s). Work shall include the following:

1. Provide a 120/208 volt, 3-phase, 4-wire underground secondary electrical service from a new utility padmount transformer, installation includes transformer pad.
2. Provide electrical circuit breaker panelboards.
3. Provide electrical branch circuit connections to mechanical systems equipment.
4. Provide interior and exterior lighting and associated wiring.
5. Provide wiring devices and associated wiring.
6. Provide a fire alarm system.
7. Provide network wiring outlets and associated wiring.
8. Provide network optical fiber patch panel.
9. Provide a lightning protection system.

B. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying drawings.

C. Include any minor items of work necessary to provide a complete and fully operative electrical system.

D. Provide and installed Feeders as indicated on in the Contract Drawings.

1. Provide and install an emergency power feeders between the Panelboards, the UPS Bypass Switch, and the UPS that is being provided by the Maine Turnpike Authority.

1.02 REFERENCES

A. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.

B. ANSI / NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

C. ANSI / NFPA 70 - National Electrical Code.

D. ANSI/NFPA 72 – National Fire Alarm Code

E. ANSI / NFPA 101 - Life Safety Code.

F. NEMA OS-1 – Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

G. NEMA WD 1 – General Purpose Wiring Devices.

H. NEMA TC 2 – Schedule 40 PVC conduit

I. NFPA 780 – Standard for the Installation of Lightning Protection Systems

J. UL 38 – Manually Actuated Signaling Boxes

K. UL 50 – Cabinets and Boxes

L. UL 96A – Installation Requirements for Lightning Protection Systems

M. UL 864 – Control Units for Fire Protective Signaling Systems

N. UL 268 – Smoke Detectors for Fire Protective Signaling Systems

O. UL 346 – Waterflow Indicators for Fire Protective Signaling Systems

P. UL 464 – Audible Signaling Appliances

Q. UL 521 – Heat Detectors for Fire Protective Signaling Systems

R. UL 1971 – Visual Notification Appliances

1.03 GENERAL REQUIREMENTS

A. Contractor shall read the entire specifications covering other branches of work. They are responsible for coordination of their work with work performed by other trades.

B. Consult all Contract drawings which may affect the location of any equipment or apparatus furnished under this work and make minor adjustments in location as necessary to secure coordination.

C. System layout is schematic and exact locations shall be determined by structural and other conditions. This shall not be construed to mean that the design of the system may be arbitrarily changed. The equipment layout is to fit into the building as constructed and to coordinate with equipment included under other Divisions of work.

D. Contractor shall contact the Owner's Representative immediately if he notices any discrepancies or omissions in either the drawings or the specifications, or if there are any questions regarding the meaning or intent thereof.

E. Submit all changes, other than minor adjustments, to the Architect for approval before proceeding with the work.

F. Contractor shall meet with Architect on site prior to rough-in of electrical to verify location of lighting fixtures, wiring devices, fire alarm devices, telephone and cable.

G. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10 feet of length shown for all local data outlets.

H. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.04 SUBMITTALS

A. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in single submittals.

B. Mark dimensions and values in units to match those specified.

C. Contractor shall check all shop drawings for dimensional correctness, interferences and conformance to specifications and plans. Stamp drawings "approved" and indicate when stipulated check has been made before forwarding them. Identify submittal data by project name and equipment identification number.

D. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Contract Drawings. The Engineer's approval shall in no way relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship required by the Contract Drawings and Specifications which may, or may not be indicated on the Shop Drawings.

E. Submit lightning protection air terminals and mounting accessories, grounding conductors, grounding electrodes, and ground connection equipment

F. Submit lightning protection system details, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal

G. Submit lightning protection qualification data for firms and persons. Include data

on listing or certification by an NRTL or LPI.

H. Submit lightning protection field inspection reports indicating compliance with UL Master Label Certification.

1.05 REGULATORY REQUIREMENTS

A. Complete installation shall conform with all applicable Federal, State and Local laws, Codes and Ordinances, included but not limited to latest approved editions of the following:

1. State Building Codes.
2. Specific Construction Safety Requirements, State Industrial Commission.
3. National Electrical Code (NFPA 70).
4. Life Safety Code, NFPA 101.
5. Occupational Safety and Health Act (OSHA) of 1971 and all amendments thereto.
6. Local Building Code(s).
7. Maine Turnpike Authority Standards
8. National Fire Alarm Code (NFPA 72)
9. Americans with Disabilities Act (ADA)

B. Manufacture, test, and install all work in accordance with applicable publications and standards of the following organizations:

1. American Society for Testing and Materials (ASTM)
2. Underwriters' Laboratories, Inc. (UL)
3. Insulated Power Cable Engineers Association (IPCEA)
4. National Electrical Manufacturers Association (NEMA)
5. Institute of Electrical and Elec Engineers (IEEE)
6. American National Standards Institute (ANSI)
7. National Fire Protection Association (NFPA)
8. Environmental Protection Agency (EPA)
9. National Board of Fire Underwriters
10. Occupational Safety and Health Organization

C. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are thereby included in these specifications.

D. The Contractor shall visit the site to become familiar with all existing conditions affecting this work. No claim will be recognized for extra compensation due to failure of contractor to familiarize himself/herself with the conditions and extent of proposed work.

E. The Contractor shall obtain state electrical permits. Request inspections from

authority having jurisdiction.

F. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Local Protected Premises Signaling Systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

G. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Auxiliary Protected Premises Signaling Systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

H. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

1.06 LIGHTNING PROTECTION QUALITY ASSURANCE

A. Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer. Installer shall be UL listed as a lighting protection installer.

B. All system components utilized in the installation shall comply with the Standard for Lightning Protection Components, UL 96A.

1.07 RECORD DRAWINGS

A. Final Submittals:
   1. As-built drawings:
      a. During progress of the work, maintain an accurate record of the installation of the electrical system Record any changes in location of boxes, service runs, locating each circuit precisely by dimension.
      b. Upon completion of the electrical installation, transfer all record data to blueline prints of the original Drawings and deliver them to the Owner’s Representative upon completion of the work.

   2. Manual:
      a. Upon completion of the electrical installation, and as a condition of its acceptance, deliver to the Owner and the Engineer one copy each of a Manual complied in accordance with the provisions of Section 1 of these Specifications; include one copy of as-built Drawings in each copy of the Manual.

1.08 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide a Complete Instruction and Maintenance Manual: Prepare in the form of an instructional manual for use by Owner's personnel. Provide one (1) draft copy and two (2) final copies.

1. Format:
2. Size: 8-1/2" x 11", 20 lb. minimum weight white paper for typed pages, either manufacturer's printed data, or neatly typewritten.
3. Single-sheet product literature and contractor-prepared pages: Provide reinforced punched binder tab.
4. Cover: Identify each volume with typed or printed title "ELECTRICAL SYSTEMS OPERATING AND MAINTENANCE INSTRUCTIONS".

1.09 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner and Architect before proceeding

1.10 ELECTRICAL MOTORS

A. In general, motors will be furnished and installed under other Divisions of work as a factory-installed item. Unless they are factory installed on the unit, all wiring, safety switches and motor starters shall be furnished and installed by the Electrical Contractor, field coordinate prior to bids.

B. Electrical Contractor shall obtain all wiring diagrams necessary to connect and control equipment requiring electrical energy.

1.11 TEMPORARY POWER AND LIGHTING

A. The Contractor shall be responsible for provision of temporary electrical power and lighting as required to facilitate construction work.

1. Temporary electrical power shall be obtained from the serving electrical utility company.
2. The Contractor shall provide temporary electrical power distribution as required to facilitate construction activities including:

a. Wire/conduit
b. Over-current protection

c. Receptacle outlets
d. Motor disconnect means
e. Grounding

3. The Contractor shall provide temporary lighting as required to facilitate construction activities.

4. All temporary electrical power and lighting shall be completely removed prior to substantial completion of the project.

1.12 WARRANTIES

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of Substantial Completion.

1.13 ELECTRICAL IDENTIFICATION

A. Nameplates:

1. Provide engraved white laminated phenolic nameplates with black core for all panelboard, main service switchboard, motor starters, disconnects, control stations, etc.
2. Secure nameplates to units by screws.
3. Adhesive units are not acceptable.
4. Nameplates for equipment other than distribution equipment shall state which unit it is for.

B. Color-Coded Conduit Markers:

1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Except as otherwise indicated, provide lettering which indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.

   a. Colors: Unless otherwise indicated or required by governing regulations, provide white markers with black letters.

C. Color-Coded Plastic Tape:
1. General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.

a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.

D. Underground-Type Detectable Warning Tape:

1. General: Manufacturer's standard permanent, bright-colored, continuous-printed tape with solid aluminum foil core, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with imprinted warning which most accurately indicates type of service of buried cable.

E. Cable/Conductor Identification Bands:

1. General: Provide manufacturer's standard aluminum wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.

F. Plasticized Tags:

1. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

G. Lettering And Graphics:

1. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

1.14 EQUIPMENT FINISHES

A. All finishes shall be in good condition at the completion of the job.

B. Restore paint on all cabinets and enclosures by complete repainting if necessary because of damage to exterior finishes.

1.15 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. The Contractor shall arrange for the equipment manufacturer to furnish the services of a qualified representative as necessary to check and supervise installations, to

supervise its initial operation, and instruct operators in operation and proper maintenance.

1.16 TESTING

A. General:

1. Demonstrate by conducting a test that the electrical system functions and performs as required to meet the needs of the Owner, and in accordance with the Drawings and specifications.
2. Furnish personnel and calibrated instruments required for the tests and the Owner shall furnish power.
3. Conduct tests at a time acceptable to the Contractor and Owner.
4. Take ammeter and voltmeter readings of all motors when the motors are operating under maximum design system loads.
5. Clean and dry motors, contacts, relays, bus, insulators, and other electrical apparatus if required.
6. Prior to applying voltage to any apparatus or circuit, make insulation resistance tests and, if necessary, dry the apparatus until resistance values conform to the standards of IEEE.
7. In drying out, use methods such that the insulation temperature of the apparatus does not exceed 90ºC.
8. In case of a low resistance circuit insulation, eliminate the problem before the circuit is energized.
9. Make a recheck after apparatus is dry.
10. Record all insulation values and furnish to the owner for review.
11. Prior to the start of check-out and testing, insure that all equipment is properly and permanently identified.
12. Before energizing any electrical equipment or apparatus, check and verify that no tools, filings, foreign matter or other materials are left inside equipment or enclosures, particularly, bus conductors, conductor, terminal blocks and windings.
13. Check screw and bolt connections and terminal connections for tightness prior to final tests and energization.
14. Check the bearings of all rotating electrical apparatus and, if required, fill with the grease or oil as recommended by the manufacturers.
15. Provide 500 and 1000 V "megger" insulation testing during the construction and check-out period.
16. Megger motors and feeder cable from the starters prior to energizing and at the time of final checkout.
17. Check all motors for rotation and, if necessary, reverse the connections at the starter (for 3 phase) and/or at the motor (1 phase).
18. Test all main loops and major equipment grounds to remote earth or directly referenced to an extremely low resistance (approximately 20 ohms) reference ground benchmark.
19. Record, witness, and report ground test results to the Architect.

20. Make tests with ground testing ohm meter or megger.
21. Measure ground resistance of the individual networks at 2 points with cables at all the test points disconnected.
22. Reconnect the cables at the test points and make a duplicate set of ground resistance measurements.
23. Resistance shall not exceed 20 ohms.
24. Drive additional ground rods, if necessary.
25. Check all control circuits to see that their operation and sequence are correct.
26. Adjust any adjustable switches such as float switches, limit switches and timers for proper operation.
27. Prior to acceptance of the lighting facilities, clean all lighting fixtures and relamp where required at no additional cost to the Owner.
28. Replace all electrical equipment, wiring, switches, and insulators found to be defective or to have failed due to poor workmanship promptly at no additional cost to the Owner.

PART 2 – PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 260501

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Alpha Wire Company.
   2. General Cable Technologies Corporation.
   3. Southwire Company.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in VFC circuits.

E. Conductors: Copper only, #12 AWG minimum size. complying with NEMA WC 70/ICEA S-95-658.
   1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 (for branch circuits) and Type XHHW-2 (for panel feeders and exterior circuits).
   2. Insulation Voltage Rating: 600 volts.

F. Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 METAL CLAD CABLE

A. Description: NFPA 70 Type MC.

B. Conductor: Copper only, #12 AWG minimum size.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: THHW 75°C.

E. Insulation Material: Thermoplastic.

F. Armor Material: Steel or Aluminum, interlocking tape.

2.3 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Hubbell Power Systems, Inc.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation, A Member of the ABB Group.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. All wire shall be stranded.

B. Branch Circuits: Copper. All wire shall be stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW-2, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Provide type MC cable where concealed in partitions and/or above accessible ceiling.

1. Install wiring in accordance with manufacturers' instructions.
2. Neatly train and lace wiring inside boxes, equipment, and panelboards.
3. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor. Use insulated spring wire connectors with plastic caps for conductor splices and taps, 10 AWG and smaller.
4. Use 10 AWG conductors for 20-ampere, 120-volt branch circuits longer than 75 feet.
5. Verify continuity of each branch circuit conductor after installation.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
      g. Continuity test on each conductor and cable.
      h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

C. Service Grounding:

1. Provide and install a new copper service ground bar at the Toll Utility Room 104 in the Administration Building. Connect the ground bar with service grounding to both a ¾ inch diameter by 10-foot-long copper-clad steel ground rod, as well as the water service entrance pipe.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning & Grounding.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation, A Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

D. Grounding electrode conductors shall be stranded cable and be sized in accordance with Table 250.66 of the National Electrical Code.

E. Equipment Grounding Conductors: Insulated with green-colored insulation, #12 AWG, minimum.

F. Isolated Ground Conductors: Insulated with green-colored insulation with yellow strip. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

G. Grounding Electrode Conductors: Stranded cable.

H. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: All conductors shall be stranded.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
   1. Bury at least 24 inches below grade.

C. Provide insulated ground conductors with all branch circuits.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

F. Terminate each ground conductor end on a grounding lug, bus, or bushing.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrodes at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed 5 Ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Cable Tray

   1. Description:
   2. Aluminum ventilated trough type cable tray attached to the wall and ceiling.
   3. Wall Height: 4-inches
   4. Width: 12-inches
   5. Manufacturers:
      a. Eaton *B-Line* model 24-A-09-12 or approved equal.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Steel slotted support systems.
   2. Trapeze hangers. Include Product Data for components.
   3. Equipment supports.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. ERICO International Corporation.
d. Thomas & Betts Corporation, A Member of the ABB Group.
e. Unistrut; Part of Atkore International.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.
4. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
5. Rated Strength: Selected to suit applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
        1) B-line, an Eaton business.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti, Inc.
        4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of .

B. Touchup: Provide cleaning and touchup painting of affected field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. Calconduit.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Southwire Company.
6. Thomas & Betts Corporation, A Member of the ABB Group.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Rigid steel conduit (RGS) Galvanized rigid steel (GRC): Comply with ANSI C80.1 and UL 6.
1. Fittings: ANSI/NEMA FB1, threaded-type

D. Electrical Metallic Tubing (EMT): Comply with ANSI C80.3 and UL 797, ¾” minimum size.
1. Fittings: Set screw-type ANSI/NEMA FB1.

E. Flexible Metal Conduit (FMC): Comply with UL 1; Steel, ¾” minimum size.
1. Fittings: ANSI/NEMA FB1.

F. Liquid-Type Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.
   1. Fittings: ANSI/NEMA FB1.

G. Plastic Conduit: NEMA TC-2 Schedule 40 PVC and Schedule 80 PVC.
   1. Fittings: NEMA TC-3

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Fittings for EMT:
      a. Material: Steel.
      b. Type: compression.
   2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. AFC Cable Systems; a part of Atkore International.
   2. CANTEX INC.
   3. Condux International, Inc.
   4. Thomas & Betts Corporation, A Member of the ABB Group.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
   2. Hoffman; a brand of Pentair Equipment Protection.
   3. MonoSystems, Inc.
   4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 (indoors), NEMA 4 (outdoors) unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1. Crouse-Hinds, an Eaton business.
   2. EGS/Appleton Electric.
   3. Hoffman; a brand of Pentair Equipment Protection.
   4. Hubbell Incorporated.
   5. O-Z/Gedney; a brand of Emerson Industrial Automation.
   6. RACO; Hubbell.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are prohibited.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC.
4. Concealed in Ceilings and Interior Walls and Partitions: MC Cable.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

I. Arrange exposed conduit to maintain headroom and present a neat appearance. Route exposed conduit parallel and perpendicular to walls, building structure and adjacent piping.

J. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction before conductors are pulled.

K. Cut conduit square using a saw or pipecutter; de-burr cut ends.

L. Bring conduit to the shoulder of fittings and couplings and fasten securely.

M. Install no more than the equivalent of three 90-degree bends between boxes.

N. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

O. Support conduit within 12 inches of enclosures to which attached.

P. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-footintervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
5. Change from EPC-40-PVC to GRC before rising above floor.

Q. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

T. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

U. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

V. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

W. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

X. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Y. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

Z. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

AA. Expansion-Joint Fittings:

1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
d. Attics: 135 deg F temperature change.

3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

BB. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers, outside HVAC condensing units, and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

CC. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

DD. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

EE. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

FF. Locate boxes so that cover or plate will not span different building finishes.

GG. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

HH. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.

3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
5. Provide PVC schedule 40 conduit for all exterior underground locations.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,

C. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color

markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    a. Power transfer switches.
    b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters

on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Emergency system boxes and enclosures.
e. Enclosed switches.
f. Enclosed circuit breakers.
g. Enclosed controllers.
h. Power transfer equipment.
i. Contactors.
j. Remote-controlled switches, dimmer modules, and control devices.
k. Power-generating units.
l. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and equipment evaluation reports.
   3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ESA Inc.
2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.

5. Panelboard designations.

D. Study Input Data. Obtain available fault current information for the utility service from the power company for use in the study.

E. Short-Circuit Study:
   1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Equivalent impedance.
   2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Calculated asymmetrical fault currents:
         1) Based on fault-point X/R ratio.
         2) Based on calculated symmetrical value multiplied by 1.6.
         3) Based on calculated symmetrical value multiplied by 2.7.
   3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation

exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
    a. Power utility's overcurrent protective device.
    b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    e. Cables and conductors damage curves.
    f. Ground-fault protective devices.
    g. Motor-starting characteristics and motor damage points.
    h. Generator short-circuit decrement curve and generator damage point.
    i. The largest feeder circuit breaker in each panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
    1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the largest branch circuit overcurrent protective device in each panel.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

I. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

J. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Standby generators and automatic transfer switches.
   3. Branch circuit panelboards.

L. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Adequacy of panelboard bus bars to withstand short-circuit stresses.
   3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.
   1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Electrical power utility impedance at the service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus, three phase and line-to-ground.
   5. Full-load current of all loads.
   6. Voltage level at each bus.
   7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
   10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   11. Motor horsepower and NEMA MG 1 code letter designation.
   12. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
   13. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
       a. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
       b. Generator thermal-damage curve.
       c. Ratings, types, and settings of utility company's overcurrent protective devices.
       d. Special overcurrent protective device settings or types stipulated by utility company.
       e. Time-current-characteristic curves of devices indicated to be coordinated.

f. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
g. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
h. Panelboard ampacity, and SCCR in amperes rms symmetrical.

3.4 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

END OF SECTION 260573

SECTION 260574

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: Provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ESA Inc.
   2. Power Analytics, Corporation.
   3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. As specified in Section 260573 – Overcurrent Protective Device Coordination Study

2.3 ARC-FLASH STUDY REPORT CONTENT

A. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Working distance.

6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

B. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.4 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the disconnect switch/overcurrent protective device for each panel and piece of equipment.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Standby generators and automatic transfer switches.
   3. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.
   1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
   2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond three to five cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating and impedance.
   6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
   7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
   9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   10. Motor horsepower and NEMA MG 1 code letter designation.
   11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
   12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING

A. Apply one arc-flash label for 208-V ac panelboards, transfer switch, and disconnects.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

END OF SECTION 260574

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motion and Daylighting Sensor Control
2. Emergency Lighting Control

B. Related Sections:

1. Section 265100 Interior Lighting
2. Section 265600 Exterior Lighting

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Emergency Lighting Control

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

B. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. UNDERWRITERS LABORATORIES (UL)

a. UL 924 (2006; Reprint Oct 2009) Standard for Emergency Lighting and Power Equipment

1.3 ACTION SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

1. Shop Drawings:
    a. Composite Wiring Diagram
        1) Submit Composite Wiring Diagram and/or schematic diagram of each control circuit as proposed to be installed (standard diagram will not be accepted).
    b. Scale Drawings
        1) Submit scale drawings for each area showing exact location of each sensor, room controller, and digital switch.

2. Product Data:
    a. Submit catalog sheets and specifications. Include data for each device which:
        1) Indicates where sensor is proposed to be installed.
        2) Prove that the sensor is suitable for the proposed application.

3. Manufacturer's Instructions:
    a. Installation Instructions:
        1) Submit Installation Instructions for each device which:
            a) Indicates where sensor is proposed to be installed.
        2) Prove that the sensor is suitable for the proposed application.

1.4 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local Energy Codes are more stringent (except plug load control), provide a minimum application of lighting controls as follows:

1. Provide a minimum of one room controller per room. A uniquely switched relay must be provided for each uniquely controlled lighting zone in the room.

2. Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except corridors, toilet rooms, utility rooms, open plan system or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room and training room. Provide occupancy/vacancy sensors with Automatic-ON functionality for all corridors, open offices, utility rooms, and toilet rooms. Provide a weatherproof rated photocell wall mounted providing control to a 20A rated lighting contactor in the mechanical room for control of the normally powered outdoor lighting. The stub mounted photocell shall be installed facing north.

3. Task Lighting / Plug Loads – No plug load control will be required.

4. Daylit Areas – All luminaries within 15' of windows shall be controlled separately from luminaires outside of daylit zones.

5. Daytime setpoints for total ambient illumination (combined daylight and electric light) level that initiate dimming shall be programmed to be not less than 125% of the nighttime maintained designed illumination levels.
6. Manual dimming controls shall be provided in all rooms except toilet rooms, storage rooms, and utility rooms.
7. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
8. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
9. Provide a maximum dimming speed of 13% per second. Dimming levels shall be adjusted by daylighting controls, occupancy sensor controls and manual dimming devices. Sudden light output changes are prohibited.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish 3 copies of an Operations and Maintenance Manual including product submittal information, equipment identification with serial numbers of each component, wiring diagrams, control diagrams, startup and operating procedures and instructions, emergency manuals, emergency procedures and instructions, inspection procedures, maintenance schedule, maintenance procedures and documentation, shutdown instructions, license requirements including inspection and renewal dates, performance curves, engineering data and tests, list of tools and replacement items recommended to be stored at Project for ready access, training plan, maintenance service contracts, and warranties and bonds.

1.6 QUALITY ASSURANCE

A. Manufacturer: Minimum (10) years-experience in manufacture of lighting controls.

1.7 COORDINATION

A. Coordinate layout and installation of lighting controls with other construction that penetrates ceilings or is supported by them, including lighting, fire alarm, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

A. Provide a five (5) year complete manufacturer's warranty on all products to be free of manufacturer's defects.

1.9 MAINTENANCE

A. Spare Parts: Provide one (1) of each product to be used for maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The basis of design for the lighting control system is the Wattstopper Digital Lighting Management (DLM) system. Other manufacturers' systems will be considered for approval if they provide equivalent functionality.

2.2 SINGLE/DUAL RELAY WALL SWITCH OCCUPANCY SENSORS

A. Dual technology (passive infrared and ultrasonic) wall switch occupancy/vacancy sensor. Furnish the Company's model which suits the electrical system parameters and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Wall or ceiling mounted (to suit installation) dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters. The minimum number of sensors shall be as indicated on the contract drawings.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton programming for the following variables:
    a. Sensitivity – 0-100% in 10% increments
    b. Time delay – 1-30 minutes in 1-minute increments
    c. Test mode – Five second time delay
    d. Detection technology – PIR, Ultrasonic or Dual B Technology activation and/or re-activation.
    e. Walk-through mode
    f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the local lighting control network.

2. One or two RJ-45 port(s) for connection to local lighting control network.

3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

4. Device Status LEDs including:
    a. PIR Detection
    b. Ultrasonic detection
    c. Configuration mode
    d. Load binding

5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

6. Manual override of controlled loads.

C. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology local lighting control network. No additional configuration will be required.

2.4 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Red configuration LED on each switch that blinks to indicate data transmission.

4. Blue Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED
b. Dim locator level indicates power to switch
c. Bright status level indicates that load or scene is active

5. Dimming switches shall include greater than 5 bi-level LEDs to indicate load levels using greater than 10 steps.

B. Two RJ-45 ports for connection to local lighting control network.

C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology local lighting control network. No additional configuration will be required to achieve multi-way switching.

D. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

2. Individual button function may be configured to Toggle, On only or Off only.

3. Individual scenes may be locked to prevent unauthorized change

4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.

5. Ramp rate may be adjusted for each dimmer switch.

6. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.

2.5 CONFIGURATION TOOLS

A. Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.

B. Contractor shall provide two (2) handheld configuration tools which shall be handed to owner after start-up.

2.6 ROOM CONTROLLERS

A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.

2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.

3. Device Status LEDs to indicate:

    a. Data transmission
    b. Device has power
    c. Status for each load
    d. Configuration status

4. Quick installation features including:

    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable

5. Standard junction box mounting

6. Manual override and LED indication for each load

7. Dual voltage (120/277 VAC, 60 Hz)

8. Zero cross circuitry for each load.

B. On/Off Room Controllers shall include:

1. One, two or three relay configuration

2. Efficient 150 mA switching power supply

3. Multiple RJ-45 local lighting control network ports

4. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.

   a. One relay configuration only
   b. Automatic-ON/OFF configuration

C. On/Off/Dimming enhanced Room Controllers shall include:

1. Real time current monitoring

2. One, two or three relay configuration

3. Efficient 250 mA switching power supply

4. Four RJ-45 local lighting control network ports

5. One 0–10-volt analog output per relay for control of compatible ballasts and LED drivers

6. The following dimming attributes may be changed or selected using a wireless configuration tool:

   a. Establish preset level for each load from 0-100%
   b. Set high and low trim for each load
   c. Set lamp burn in time for each load up to 100 hours

7. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.

   a. One relay configuration only
   b. Automatic-ON/OFF configuration

2.7 DIGITAL INDOOR PHOTOSENSORS

A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Open loop photosensors measure incoming daylight in the space and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:

1. An internal photodiode that measures only within the visible spectrum and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of

less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

2. Sensor light level range shall be from 1-10,000 footcandles (fc).

3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).

4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.

5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.

6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.

7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.

8. Red configuration LED that blinks to indicate data transmission.

9. Blue status LED indicates test mode, override mode and load binding.

10. Recessed switch to turn controlled load(s) ON and OFF.

11. One RJ-45 port for connection to local lighting control network.

12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

C. All photosensors shall be open loop.

D. Open loop digital photosensors include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.

2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.

3. A proportional control algorithm for dimming daylight harvesting with a "Setpoint" to be maintained during operation.

2.8 OUTDOOR WEATHERPROOF PHOTOCELL

A. Photocell shall be Intermatic model K4251 or approved equal.

B. Photocell shall have a minimum of 30 second sensor time delay.

C. Photocell housing shall be constructed of high strength, UV resistant plastic.

D. Photocell shall have an operating temperature range of -40°C to 70°C.

E. Photocell shall be installed facing skyward, oriented towards the north.

2.9 EMERGENCY LIGHTING

A. Emergency Lighting Control Unit - A UL 924A listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz., 20-amp ballast rating

2. Push to test button

3. Auxiliary contact for remote test or fire alarm system interface

2.10 LIGHTING CONTACTOR

A. Lighting Contactors shall be of the type and maximum dimensions detailed on the contract drawings. Contacts shall be electrically held, with a 3 position (hand-off-auto) selector switch. Contactors shall be provided in a NEMA 1 enclosure. Hand-off-auto selector switch shall be mounted to the front cover of the enclosure. Enclosure shall be constructed from steel and factory painted after fabrication.

PART 3 - EXECUTION

3.1 INSTALLATION

A. When using wire for connections other than the local lighting control network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.

B. The room controllers shall be located/mounted on the wall above the drop ceiling/plenum over the door/entry point of each room. If there are multiple doors/entry points, the room controller shall be located over the main entry point or the door closest to the panel powering the lighting.

C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

1. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.

E. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

2. Sequence of operation, (e.g., manual ON, Auto OFF. etc.)

3. Load Parameters (e.g., blink warning, etc.)

F. Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.

C. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION 260923

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish 3 copies of an Operations and Maintenance Manual including product submittal information, equipment identification with serial numbers of each component, wiring diagrams, control diagrams, startup and operating procedures and instructions, emergency manuals, emergency procedures and instructions, inspection procedures, maintenance schedule, maintenance procedures and documentation, shutdown instructions, license requirements including inspection and renewal dates, performance curves, engineering data and tests, list of tools and replacement items recommended to be stored at Project for ready access, training plan, maintenance service contracts, and warranties and bonds. Also include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 or NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cutler-Hammer; Eaton.
2. General Electric Company.
3. Square D; Schneider Electric.
4. Siemens Industry, Inc.
5. Substitutions: None Permitted

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Finishes:

   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: Top or bottom. Contractor to coordinate locations.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rated devices are not permitted.

2.2 PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Provide panelboards with copper bus, ratings as scheduled. Provide copper ground bus in all panelboards.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
   1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Minimum Integrated Short Circuit Rating: 22,000 amperes symmetrical for 120/208 volt panelboards

E. Mains: Circuit breaker, electronic trip.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on thermal magnetic circuit breakers.

G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and larger: Bolt-on electronic trip, circuit breakers.

H. Provide surface-mounted and recessed cabinets with screw covers as indicated on the plans.

I. Finish in manufacturer's standard gray enamel.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cutler-Hammer; Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens.
4. Square D; by Schneider Electric.
5. Substitutions: None Permitted

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Bolt-on Adjustable magnetic trip setting for circuit-breaker frame sizes 125 A and larger.

2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I squared x t response.

3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type HACR for air conditioning equipment branch circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on position.
g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 or NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 or NEMA PB 1.1.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 79 inches above finished floor unless otherwise indicated. The operating handle of the top most circuit breaker in the on position shall not be higher than 72 inches above finished floor or grade.

D. Clearance: 3 feet in front of panelboard, floor to ceiling.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

K. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Measure state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Provide typed circuit directory for each branch circuit panelboard.; handwritten directories are not acceptable.

D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

SECTION 262713
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for electricity metering by utility company.

1.2 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.
   1. Dimensioned plans and sections or elevation layouts.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
   1. Comply with requirements of utilities providing electrical power services (CMP).
   2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Meter Sockets, Current Transfer Enclosures: Comply with requirements of electrical-power utility company (CMP).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company (MP).

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
   2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

END OF SECTION 262713

SECTION 262726
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Weather-resistant receptacles.
   3. Snap switches.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

   1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Leviton Manufacturing Co., Inc.
3. Pass & Seymour/Legrand.

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, Heavy-duty type, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Device Body: Ivory nylon (normal power circuits); Orange or White nylon (clean power circuits)
2. Model: CR20-W

B. Isolated Ground Receptacles:

1. Description:UL 39121406; 125 volt, isolated ground type duplex receptacle.
2. Device Body: Thermoplastic.
3. Color: White, or as selected by Architect
4. Configuration: NEMA 5-20.
5. Model Number: IG5362WSP

2.4 GFCI RECEPTACLES

A. GFCI Convenience Receptacles, 125 V, 20 A, Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

1. Straight blade, feed or non-feed-through type.

2. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
3. Device Body: Thermoplastic.
4. Color: White, or as selected by Architect
5. Configuration: NEMA 5-20.
6. Model Number: 2095-W

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Description:

a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Server Isolated Ground, Twist-Lock Receptacle:

1. Description: UL 1449; 125 volt, isolated ground twist-lock type single receptacle.

a. Device Body: Orange, Thermoplastic.
b. Configuration: NEMA L5-20R.
c. Model Number: IGL520-R

2.6 CORD AND PLUG SETS

A. Description:
1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole - Pass & Seymour; CSB20AC1.

b. Two Pole - Pass & Seymour; CSB20AC2.
c. Three Way - Pass & Seymour; CSB20AC3.
d. Four Way - Pass & Seymour; CSB20AC4.

2. Color: White, or as selected by Architect

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Stainless steel.
3. Material for Unfinished Spaces: Stainless steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.
5. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
6. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
7. Use stamped steel bridges to fasten flush mounting outlet box between studs.
8. Use gang boxes where more than one device is mounted together. Do not use sectional box. Provide 2-gang plaster rings for 2-gang boxes.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
10. Verify wall openings are neatly cut and will be completely covered by wall plates.
11. Provide extension rings to bring outlet boxes flush with finished surface.
12. Install products in accordance with manufacturer’s instructions.
13. Install devices plumb and level.
14. Install switches with OFF position down.
15. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
16. Adjust devices and wall plates to be flush and level.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

H. Install electrical boxes as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

I. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

J. Support boxes independently of conduit.

K. Use flush mounting outlet boxes in finished areas.

L. Do not install flush mounting boxes back-to-back in walls; provide minimum 24 inches separation in walls.

M. Align adjacent wall-mounted outlet boxes for fire alarm devices, switches, receptacle outlets, intercom call stations, telecommunications outlets, thermostats, and similar devices with each other.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

B. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 200ft.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cutler-Hammer; Eaton.
b. General Electric Company.
c. Siemens Industry, Inc.
d. Square D; by Schneider Electric.
e. Substitutions: None Permitted.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses (per manufacturers requirements), lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Compression type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cutler-Hammer; Eaton.
b. General Electric Company.
c. Siemens Industry, Inc.
d. Square D; by Schneider Electric.
e. Substitutions: None Permitted.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 CIRCUIT BREAKERS

A. Description:

1. Molded Case Circuit Breakers: NEMA AB 1; provide bolt-on circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide disconnect switches for all mechanical systems motorized equipment that is not furnished with an integral means of disconnect.

B. Mount disconnect switch within sight of motors being served.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

SECTION 264113

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes lightning protection for structures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label or LPI System Certificate.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

a. Advanced Lightning Technology, Ltd.
b. ERICO International Corporation.
c. Harger Lightning & Grounding.
d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Robbins Lightning, Inc.
g. Thompson Lightning Protection, Inc.

2. Air Terminals shall be NFPA Class I, solid copper, 3/8” diameter, by 24” tall or 10” tall, as indicated on the Contract Drawings.
3. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
4. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: As indicated on plans.

E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: Solid copper.

G. Main roof conductors as down conductors shall be bare copper in sizes as indicated on the Contract Drawings. Grounding electrodes shall be copper-clad steel, 3/4" diameter by 10'-0" long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All work shall conform to the requirements contained in the latest edition of UL 96A, Installation Requirements for Lightning Protection Systems, and in the latest edition of NFPA 780 Standard for the Installation of Lightning Protection Systems.

B. Install conductors with direct paths from air terminals to ground connections. Conductors shall be supported for their entire length without travel through free air. Avoid sharp bends. No bend of a conductor shall form an included angle of less than 90 degrees or have a radius of bend less than 8 inches.

C. Conductors shall not be directly attached to aluminum or galvanized steel. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

D. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet of building.

E. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

F. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

G. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

H. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

I. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of area or item indicated.

1. Bury ground ring not less than 24 inches from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.

J. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

K. Main conductors shall be fastened at intervals not exceeding 3 feet.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

B. Down conductors shall be installed within Schedule 80 PVC conduit for physical protection.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

SECTION 265100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LED: Light emitting diode.

F. LER: Luminaire efficacy rating.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Installation instructions.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.7 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including lighting controls, fire alarm, HVAC equipment, fire alarm system, and partition assemblies.

1.8 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four years.
2. Warranty Period for Self-Powered Exit Sign Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Furnish products as specified in the attached Lighting Fixture Schedule.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    d. CCT and CRI for all luminaires.

G. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 LED LUMINAIRES

A. Electrical

1. Operating voltage: 24 Vdc, 120 Vac at 60 Hz, 277 Vac at 60Hz, or universal voltage (120, 220/240, 277 Vac at 50/60 Hz)
2. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range)
3. Total harmonic distortion: ≤ 20% (at full luminaire output and across specified voltage range)
4. Surge protection:

    a. Interior Luminaires: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV.
    b. Exterior Luminaires: 10kV surge suppression protection tested in accordance with IEEE/ANSI C62.41.2.

5. Sound: Class A not to exceed a measured value of 24dB
6. Maximum standby power: 1W
7. Luminaires shall be tested according to IESNA LM-79 and LM-80

B. Warranty: Luminaires shall be provided with a full 5-year warranty, starting from the date of substantial completion.

C. Power Supply/Driver:

1. Driver efficiency (at full load):

    a. ≥ 85% for drivers capable of ≥ 50 watts
    b. ≥ 80% for drivers capable of < 50 watts

2. Federal Communications Commission (FCC) compliance: FCC Part 15 Class A (Commercial) requirements for EMI/RFI emissions

D. Accessibility for Maintenance

1. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire

E. Compliance Requirements

1. Luminaire shall be UL listed, or ETL listed to UL specifications.

F. Chromaticity

1. Correlated Color Temperature (CCT): Provide as indicated on luminaire schedule.
2. Acceptable tolerances as provided in ANSI C78.377
3. Color rendering index (CRI): ≥ Provide as indicated on luminaire schedule.
4. Tested per LM-79

G. Lumen maintenance/Rated lamp life

1. ≥ 77.4% of initial lumens @ 36,000 hours (this equates to a ≥ 70% of initial lumens @ 50,000 hour target.)
2. Determined by IES LM-80 data parameters (drive current and steady-state temperature)

H. Optional Provisions

1. Emergency lighting
2. Emergency battery pack available factory or field installed

I. Dimming

1. Manufacturers shall provide listing of compatible dimmers that have been tested and approved for use with their products
2. Dimming protocol

    a. Analog 0-10v dimming
    b. Continuous, flicker-free dimming from 100% to 10%

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

3. Master Sign/Remote Emergency Lighting Configurations:

    a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in battery for power connection to remote unit.
    b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.
3. Install lighting fixtures at locations indicated.
4. Install in accordance with manufacturers' instructions.
5. Bond luminaires and metal poles to branch circuit equipment grounding conductor.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48", brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 265600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior luminaires with lamps and ballasts.
   2. Accessories.

B. Related Sections:
   1. Section 265100 "Interior Lighting".

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light emitting diode.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 ACTION SUBMITTALS

A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

   1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
   2. Details of attaching luminaires and accessories.
   3. Details of installation and construction.
   4. Luminaire materials.
   5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

      a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
      b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

   6. Ballasts, including energy-efficiency data.
   7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
   8. Materials, dimensions, and finishes of poles.

9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion unless otherwise noted in the Luminaire Schedule.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion unless otherwise noted in the Luminaire Schedule.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion unless otherwise noted in the Luminaire Schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.

L. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    a. Color: White.

M. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: White.

N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USES ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    f. CCT and CRI for all luminaires.

2.3 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

B. Adjust luminaires that require field adjustment or aiming.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 10 mil. thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. UTP cabling.
2. Patch cords
3. Intra-building telecommunications cable
4. 62.5/125-micrometer, optical fiber cabling.
5. Coaxial cable.
6. Cable connecting hardware, patch panels, and cross-connects.
7. Optical Fiber patch panel.
8. Telecommunications outlet/connectors.
9. Cabling system identification products.
10. Cable management system.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

I. RCDD: Registered Communications Distribution Designer.

J. UTP: Unshielded twisted pair.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Cabling administration drawings and printouts.
2. Wiring diagrams to show typical wiring schematics, including the following:
    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.
3. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 NETWORK SYSTEM

A. The network system components shall be provided by a single source from one of the following:

1. Amp
2. Belden
3. Panduit
4. Hubbell
5. Hitachi / Superior Modular
6. Substitutions: Or Approved Equal

2.2 NETWORK RACK

A. Maine Turnpike Authority will be providing Network Racks.

2.3 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

2.4 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

1. Jumper cable shall be hollow braided, 60 amp capacity, copper.

2. Jumpers shall have compression or exothermic type terminals on both ends of cables. Terminals shall be compatible with jumper cable material and equipment material in order to not have any degenerative reaction.

2.5 UTP CABLE

A. Description: Category 6 unshielded twisted 4 pair wiring (UTP), 24 AWG. Category 6 cable shall meet the physical requirements of ANSI/ICEA publication. 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or CMG.
    b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    d. Communications, Limited Purpose: Type CMX.
    e. Multipurpose: Type MP or MPG.
    f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

5. Cable shall be tested to minimum 350 mHz. Exterior jacket color shall be blue.
6. Characteristics at 20 °C:

    a. Nominal Impedance: 100 ½ - 15% (from 1MHz to 100 MHz)
    b. Maximum DC Resistance: 9.38 ½ / 100m
    c. Mutual Capacitance (max.): 5.25 nF/100m

B. Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.6 HARDWARE

A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

B. The Telecommunications systems comprising of equipment cabinet, rack and non-current carrying metallic parts shall be grounded according to the Electrical Code.

C. Outlets shall be seated properly and shall be installed level on walls and parallel to building elements as required.

D. In general, the grounding shall be as specified, as specified and as required by the Electrical Code and Local Authorities.

E. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

F. The installer shall furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground bus bar.

G. Patch Panels – CAT6: EIA nineteen inch, 48-port, rack-mounted UL listed patch panel for cross-connect of Category 6 cables, including 8-position modular wiring jacks and color-coded, high-density IDC type terminations

H. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.

1. Description: Category 6 unshielded, twisted pair (UTP) modular line cords with No 24 AWG thermoplastic insulated solid conductors formed into 4 individually twisted pairs and enclosed in a thermoplastic jacket. Line cord shall be terminated with 8-position modular plugs at both ends, conforming to ANSI/TIA/EIA 568A. Line cords shall not exceed 3m in length. Patch cords shall be factory assembled and tested. Provide one (1) patch cord for data network outlet.

2. PIN/ PAIR assignment - Wiring shall be terminated on the 8-position modular jack to PIN/ PAIR assignment directed by OWNERS Network Coordinator.

3. Characteristics at 20 °C: Match manufacturer and characteristics requirements for intra-building telecommunications cable.

4. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2.7 COAXIAL CABLE

A. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 5 to 1000 MHz.

B. RG6/U: NFPA 70, Type CATV, CM/CL2.

1. No. 18 AWG, solid, copper-clad steel conductor; gas-injected, foam-PE insulation.
2. Dual-shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor and direct burial outdoor installations.

C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1655 and with NFPA 70 "Radio and

Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV.
2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
3. CATV Riser Rated: Type CATVR, complying with UL 1666.
4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks and Jack Assemblies: 100-ohm, Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. Jacks shall be suitable for back wiring and mounting in a standard electrical box. Jacks shall conform to UL 1863 and ANSI/TIA/EIA 568A. Comply with TIA/EIA-568-B.1.

1. Standard Jack Outlets: Duplex outlet with one RJ45 jacks (grey)

2. Network Jack Outlet

    a. AMP
    b. Hubbell
    c. Panduit
    d. Substitutions: Or Approved Equal

3. Modular Jacks: Each Category 6 jack shall have a Category 6 home cable run back to its associated patch panel.

B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Machine printed, in the field, using adhesive-tape label.

2.10 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.11 IDENTIFICATION PRODUCTS

A. All equipment and cabling shall be properly identified by means of clear and concise labels. All identification shall meet or exceed the minimum requirements of EIA/TIA568A, 606 and BICSI standards.

B. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

D. Permanently label, using pre-printed labels, all cables and terminations. Handwritten or embossed type labels are specifically prohibited.

a. Label all equipment racks, panels and cross connect blocks uniquely.
b. Label patch panels and cross connect blocks numerically, top-to-bottom.
c. Label cable segments by designated incoming cable.

E. Provide color-coded labels with CODED identifiers as follows:

a. Conduits and other pathways shall be labeled at all end points including equipment rooms, telecommunications closets, pull boxes and the like. Provide adhesive labels on the conduit with at least one label within each space that the conduit passes through. Labels shall be attached by means of the label adhesive and color-coded pressure-sensitive tape wrapped around conduit at least one and one half times.
b. Cables shall have double lapped adhesive labels at all end points including Work Area Outlets, telecommunication closets and equipment rooms. Cables shall also have factory imprinted manufacturer's name, part number and the NRTL certified UL EIA/TIA category rating designation at a minimum of two-foot (610mm) intervals along the entire length of the cable.
c. Termination hardware shall have adhesive labels on both the front and rear (if accessible) of the hardware.
d. Insert Labels shall be provided in each Work Area Outlet patch panel termination hardware (top of jack) cross connect blocks (edge of block) and the like.
e. Outlet boxes, junction boxes and the like shall have adhesive labels attached on the inside and located where visible from the outlet opening.
f. Grounding and bonding system shall have engraved labels at each ground bar and backbone grounding cable as it passes through each room. Each bonding jumper shall have heat shrink labels at all end points.

F. Labels shall be constructed of approved material in order to meet the legibility, defacement, adhesion (adhesive labels only), and exposure requirements of UL 969. All labels shall be mounted horizontally in order to be read from left to right.

a. Adhesive Labels shall be constructed of color-coded paper with a clear polyester over laminate, Brady USA, Inc. PermaShield, RayChem TMS or approved equal. Adhesive material used shall be approved for material being attached to, typeface shall be medium density, Helvetica, 1/8 inch (3mm) high black characters unless indicated otherwise.

b. Heat-Shrink Labels shall be constructed of color-coded flame retardant, heat shrinkable polyolefin, Brady USA, Inc, RayChem TMS or approved equal. Typeface shall be medium density, Helvetica 1/8 inch (3mm) high black characters unless indicated otherwise.
c. Insert Labels shall be constructed of color-coded paper inserted behind clear plastic label holder. Work Area Outlets shall have white color labels inserted behind a flush mounted (recessed) plastic window. Patch panels and cross connect block may have continuous clear plastic insertion strips label holders with label strips. Label strips shall have distinct markings to indicate where one jack or cross connect ends and the adjacent one starts. Typeface shall be medium density, Helvetica 1/8 inch (3mm) high black characters unless indicated otherwise.
d. Each Network Interface Outlet shall have each of its eight-position modular jacks provided with a color-coded, embossed modular ICON. The telephone jack icon shall be red and shall have either the word "VOICE" or a telephone logo. The data jack icon shall be blue and shall have either the word "DATA" or a computer logo. The Network Interface Outlet jack provided shall also be able to have additional ICON types such as but not limited to "LAN1 " or "LAN2" and the like available for use. Coordinate with the Owner through the Architect-Engineer, the specific icons required for this project.
e. Handwritten or embossed labels are not allowed.

2.12 OPTICAL FIBER PATCH PANEL

A. Description: Provide a wall-mounted optical fiber patch panel to receive network system optical fiber cable.

1. Patch panel shall be capable of terminating 12 pair (24 strands) of a fiber optic cable.
2. Patch panel wall mounted with an aluminum 32cm by 25cm by 5.5cm enclosure for communication and a rack mounted panel for toll equipment. Both with integral cable management, pre-loaded with duplex ST couplings.

B. Manufacturers:

1. UnitekFiber or approved equal.

2.13 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

D. Cable will be considered defective if it does not pass tests and inspections.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not install equipment and materials that have not been reviewed by the Engineer.

B. Obtain detailed information on installation requirements from the manufacturers of all equipment to be furnished, installed, or provided. At the start of construction, check all.

C. Contract Documents, including all Drawings and all Sections of the specifications for equipment requiring electrical connections and service and verify electrical characteristics of equipment prior to roughing.

D. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with the General Contractor and all other Trades.

E. Refer to all Drawings associated with the project, prior to the installation or roughing- in of the electrical outlets, conduit, and equipment, to determine the exact location of all outlets.

F. After installation, equipment shall be protected to prevent damage during the construction period. Openings in boxes shall be closed to prevent the entrance of foreign materials.

G. Home runs indicated are not to be combined or reduced without written consent from the Engineer.

H. All connections to equipment shall be made as required, and in accordance with the approved submittal and setting drawings.

I. Any ceilings, walls, floors, furniture, equipment, furnishings, etc., damaged by the work of this Section shall be replaced, or at the Owner's option, repaired with similar materials, workmanship and quality.

3.2 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.3 PATCH PANELS

A. Mount rack mounted patch panels onto the rack at the top of the rack.

B. Install the optical fiber cable patch panel on the wall at the fiber service entrance.

C. Position racks in order to have minimum 3-foot clearance for easy access.

D. Once the cabling system has been installed and terminated, install all active components and surge protected power strips into the rack.

E. MTA provided Surge Protected Outlet Strips: Mount UPS and surge protected outlet strips per Manufacturer's directions.

F. Clearances: Clearances between cabling and other building systems as required by EIA/TIA 569 and BICSI shall be maintained throughout the building.

3.4 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Maximum pulling tension shall not exceed 25 lbs/ft. when installing cables.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.
4. Cable Management: Secure the cable bundle(s) to the rack strain relief and wire management behind the patch panel. Install horizontal and side-mounted vertical cable management panels and brackets for routing and management of patch cables. Maintain EIA/TIA and BICSI standards on bundling, supporting and bend radii.

3.5 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
b. Locate consolidation points for UTP at least 49 feet from communications equipment room.

4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
12. All conductors of every cable shall be completely terminated at both ends.
13. Cable bending radius shall not be less than minimum required by EIA/TIA and BICSI.
14. Cabling installed concealed shall be supported from the building structure (e.g., J-Hooks, etc.).
15. Cables shall be installed no closer than 12 inches (305mm) to electrical equipment and wiring. When cables are required to cross power wiring, they shall only do so perpendicular to the power wiring. Telecommunications cabling and power wiring shall only cross each other the minimal number of times as required due to building design limitations.
16. All cables shall be installed in a neat and workman-like manner. Cables shall be installed parallel and perpendicular to building elements.
17. Cable ties for horizontal cables shall be secured with minimum required compression in order to secure the cables properly without impeding the signal transmission rating (geometry) of the cable. Hook and loop (Velcro) cable wraps may be used in lieu of cable ties for copper cables only.
18. When pathways are not provided or specified, provide strap supports from the building structure as required for cable runs to the cable drop location. Maximum distance between supports shall be five feet (1 500mm) depending on the structural elements of the building. Maximum number of cables per support shall be fourteen. Provide additional supports as to maintain required bending radius of cables.
19. All cables shall be supported directly from building structure. Under no circumstance shall cable be installed using cross bracing, plumbing/sprinkler pipes, ceiling systems or any other system that is not a specifically approved method to independently support cables. Cables shall not be allowed to rest on ceiling tiles, ductwork, piping, etc. Supports shall be provided as required in order for cables to avoid contact with any other building system. Bundle cables in groups by Room.
20. Protect all cables during construction. Cables damaged during installation shall not be repaired. They shall be completely replaced with new cable.
21. All cabling shall be concealed within partitions or above ceilings.
22. Routing:

a. Route cables (minimum of 12 inches (305mm) away) to avoid light ballasts, transformers, power wiring and other electrical devices so that there is no EMI or RFI interference with data transmission.
b. Cable routes shall be with 90-degree angles whenever possible. Cables shall not be installed randomly or diagonally through the building.

23. All cables shall have both ends completely terminated at their respective patch panel and Outlet Jacks. Individual conductors shall be trimmed flush with IDC block. Cables indicated to be "spare" shall have one end terminated at their respective patch panel or cross-connect block and the other end shall be hermetically sealed with a polyolefin heat-shrinkable cap. Provide RayChem Co. or approved equivalent after testing. Tape shall not be approved.
24. The total length of permanently installed cable for any complete segment shall not exceed 295 feet (90m). Do not splice or otherwise re-terminate any cable used, terminate only at the patch panels, cross connect blocks and Outlet Jacks. Route cables (minimum of 12 inches (305mm) away) to avoid light ballasts, transformers, power wiring and other electrical devices so that there is no EMI or RFI interference with data transmission. Permanently label all cables six inches from the connector at each end, according to the numbering convention outlined in the section on labeling. All cables shall be terminated at outlets, patch panels or cross connect blocks Only.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
3. Test each UTP cable and passive components. Provide certification that entire installation of UTP cabling, equipment and jacks are NRTL certified meeting or exceeding a minimum of category performance specified on all four pairs of conductors. Tests shall indicate each cable segment performance as well as each cable overall channel performance (includes patch cables at both ends of cable segments).
4. Tests shall be based on each pair of conductors and not the aggregate multiple pair results.
5. UTP Cable: Test all installed cable segments end-to-end, from the horizontal patch panel to each Work Area Outlet with a Signal Injector, Graphical Link Testing Meter and Time Domain Reflectometer (TDR) for compliance to latest EIA/TIA performance requirements, as well as NEXT, ELFEXT, structural return loss, alternating power sum, opens, shorts, continuity, cable length, and Characteristic Impedance.
6. Test results shall include:

a. Wire Map
b. Length
c. Attenuation
d. Insertion Loss
e. NEXT (Near End Cross Talk)
f. PS-NEXT (Power Sum Near End Cross Talk)
g. ELFEXT (Equal Level Far End Cross Talk
h. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)

i. Propagation Delay
j. Delay Skew
k. Impedance
l. Return Loss
m. Wire map will determine the following:

1) Continuity to the remote end
2) Shorts between any two or more conductors
3) Crossed pairs
4) Reversed pairs
5) Split pairs
6) Any other mis-wiring

n. Below are the current testing requirements in addition to the basic wire- map and length tests for Category 6 cables and the respected limits for each test parameter.

7. Length is determined by the propagation of delay of signals and depends on the twist helix and dielectric materials. Note: Calibration of nominal velocity of Propagation (NVP) is critical to the accuracy of the length measurements when estimating from either frequency or time domain methods.

a. The maximum physical lengths for:

1) Basic link = 94 meters including test equipment cords.
2) Channel = 100 meters including equipment cords and patch cords.
3) Test results shall be reported in feet.

8. Attenuation: Link attenuation shall include all connection hardware.

9. Near end Cross Talk (NEXT) Loss: Next and PS-NEXT shall be measured form both ends of the cable or link under test. For accurate measurements, at least 380 linearly spaced sample points in a 100 MHZ sweep are required.

10. When a test result is closer to the test limit than the accuracy of the field tester, the result shall be marked with an asterisk (*). Provide documentation to interpret results marked by an asterisk.

11. The Link test shall include all patch cables and line cords.

12. Any reconfiguration of link components after testing may change the performance of the link and thus invalidate the previous test result. These links shall be re-tested.

13. In general, provide certification that all cabling and equipment installed has been tested for wire mapping, cable length, NEXT, PS-NEXT, attenuation, ELFEXT, PS-ELFEXT, Return Loss, Prop. Delay and Delay Skew, shorts, opens, polarity, split pairs and that the pin configuration is consistent throughout the entire systems. (Category 6 backbone testing shall include testing for Powersum.)

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

F. FIRESTOPPING

1. Comply with requirements in Section 078413 "Penetration Firestopping."
2. Comply with TIA-569-B, Annex A, "Firestopping."
3. Comply with BICSI TDMM, "Firestopping Systems" Article.
4. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be fire stopped using approved methods and NRTL listed products to maintain the fire resistance rating.
5. Installation restrictions of the listing agencies shall be strictly adhered to (e.g., 24 inch (610 mm) minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening in wall).
6. Fire stopping in sleeves or in areas having small openings that may require the addition or modification of installed cables or raceways shall be soft, pliable, non-hardening fire stop putty. Putty shall be water resistant and intumescent.
7. Fire stopping in locations not likely to require frequent modification shall be a NRTL listed putty or caulk to meet the required fire resistance rating.
8. Where conduit penetrates smoke partitions, seal opening around conduit with dry-wall joint compound or fire stop material.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus

bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. UTP Performance Tests:

a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
   1) Wire map.
   2) Length (physical vs. electrical, and length requirements).
   3) Insertion loss.
   4) Near-end crosstalk (NEXT) loss.
   5) Power sum near-end crosstalk (PSNEXT) loss.
   6) Equal-level far-end crosstalk (ELFEXT).
   7) Power sum equal-level far-end crosstalk (PSELFEXT).
   8) Return loss.
   9) Propagation delay.
   10) Delay skew.

5. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Test Reports: Upon completion and testing of the installed system for each of the construction phases, test reports shall be submitted in booklet form showing all factory and field tests performed. Organize test reports by each telecommunication closet. Test reports shall be typewritten. Provide documentation and a copy of the standards being tested to. Indicate where test is in compliance, and acceptable limits for the test, measured value of the test and application involved. Submit test report formats for approval during shop drawing review.

E. The system shall not be considered certified until the tester has acknowledged, in writing, that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.

F. Equipment Manufacturer's Factory Test

1. Each cable and equipment manufacturer shall factory test their respective products being installed on this project and provide test reports at time of delivery. Provide separate respective test reports indicating that they meet or exceed the latest applicable TIA/EIA Standards and technical bulletins.
2. All other products relative to this specification shall be tested to its respective industry strictest standards.
3. Each manufacturer shall factory test their respective cable or equipment provided to this project at several lower frequency levels, including the minimum and maximum frequency level indicated herein. The test reports shall indicate test results for at least five equal incremental frequency levels including the maximum required.

G. Field Testing Equipment: Submit during shop drawing review on the testing equipment to be utilized on this project. The installer shall test all cables installed under this Section. Provide a hard copy of all field-testing.

1. Unshielded and Shielded twisted pair Testing Equipment:

a. The cable tester shall have a wide variety of preprogrammed cable types as an integral part of its testing system and have the ability to test cables less than 6 feet (6ft.) from the test point.

H. Cable tester shall be NRTL certified for EIA/TIA TSB95

I. Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).

J. Upon completion of all work, and testing, thoroughly inspect all exposed portions of the installation and completely remove all exposed labels, markings, and foreign material.

K. Repair damage to finish surfaces resulting from work under this Section. Touch up all damaged pre-finished equipment using materials and methods recommended by the Manufacturer.

END OF SECTION 271500

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital/Cellular alarm communicator transmitter.
9. Radio alarm transmitter.

B. Related Requirements:

1. Section 260533 "Raceways and Boxes for Electrical Systems".

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor

sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish 3 copies of an Operations and Maintenance Manual including product submittal information, equipment identification with serial numbers of each component, wiring diagrams, control diagrams, startup and operating procedures and instructions, emergency manuals, emergency procedures and instructions, inspection procedures, maintenance schedule, maintenance procedures and documentation, shutdown

instructions, license requirements including inspection and renewal dates, performance curves, engineering data and tests, list of tools and replacement items recommended to be stored at Project for ready access, training plan, maintenance service contracts, and warranties and bonds.

1. Include the following and deliver copies to authorities having jurisdiction:
    a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    d. Riser diagram.
    e. Device addresses.
    f. Record copy of site-specific software.
    g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
        1) Equipment tested.
        2) Frequency of testing of installed components.
        3) Frequency of inspection of installed components.
        4) Requirements and recommendations related to results of maintenance.
        5) Manufacturer's user training manuals.
    h. Manufacturer's required maintenance related to system warranty requirements.
    i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.

6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.8 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B), Style 6 (Class A) or Style 7 (Class A) Signaling Line Circuits (SLC).
2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) or Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) or Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
4. All circuits shall be power-limited, per UL864 9th edition requirements.

5. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm when wire NFPA Style 6/7.
6. Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.

B. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

C. Noncoded, UL-certified FM Global-placarded addressable system, with multiplexed signal transmission and horn/strobe evacuation.

D. Automatic sensitivity control of certain smoke detectors.

E. All components provided shall be listed for use with the selected system.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. User disabling of zones or individual devices.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.

7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.

2.3 PERFORMANCE REQUIREMENTS

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment, and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a fire protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. *Notifier* NFW-50 (Fire Warden-50)
2. Substitutions: Or Approved Equal.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 0.
3. Install no more than 100 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

a. One dedicated RS 485 port for central-station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One RS 232 port for PC configuration.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
4. The detectors shall be ceiling-mounted and available in an alternate model with an integral fixed 135-degree heat-sensing element.
5. Each detector shall contain a remote LED output and a built-in test switch.
6. Detector shall be provided on a twist-lock base.
7. It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
8. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall periodically flash to indicate that the detector is in communication with the control panel.
9. The detector shall not go into alarm when exposed to air velocities of up to 1500 feet per minute (fpm).
10. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
11. All field wire connections shall be made to the base through the use of a clamping plate and screw

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg For a rate of rise that exceeds 15 deg Fper minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 ADDRESSABLE DRY CONTACT MONITOR MODULE

A. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any normally open dry contact device) to one of the fire alarm control panel SLCs.

B. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

C. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

D. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

2.9 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of

90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:
    a. 15, 30, 75, 110 cd as required and determined by approved fire alarm manufacturer.
    b. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. Flashing shall be in a temporal pattern, synchronized with other units.
4. Strobe Leads: Factory connected to screw terminals.
5. Mounting Faceplate: Factory finished, red.

2.10 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush or Surface cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: 80-character back-lit Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.12 DIGITAL CELLULAR ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture the dedicated cellular communication signal line and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on signal line is interrupted for longer than 60 minutes, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of communication signal to the remote alarm receiving station over the remaining communication signaling system. Transmitter shall automatically report signal restoration to the central station. If service is lost on the communication signals, transmitter shall initiate the local trouble signal. Any failures to the system shall be annunciated to the supervising station within five minutes of the failure.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 RADIO ALARM TRANSMITTER

A. Transmitter shall comply with NFPA 1221 and 47 CFR 90. Coordinate exact requirements with the Fire Department.

B. Description: Manufacturer's standard commercial product; factory assembled, wired, and tested; ready for installation and operation.

1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
3. Normal Power Input: 120-V ac.
4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mphwith a gust factor of 1.3 without failure.
6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
7. Antenna-Cable Connectors: Weatherproof.
8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.

C. Functional Performance: Unit shall receive alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:

1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
6. Local Fire-Alarm-System, Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
3. Furnish and install new devices as described herein and as shown on the plans. Include all necessary wiring, terminations, electrical boxes, and all other necessary material to provide a complete and operational fire alarm system.
4. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
5. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
6. Manual pull stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed 48 inches (122 mm) above the finished floor.
7. Indicating stations shall be installed 80 inches (315 mm) above finished floor.
8. Equipment shall be constructed and installed be listed for the purpose for which it is used (all fire alarm equipment shall be UL or FM listed for their specific use).

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.

2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

B. Pathways shall be installed in EMT.

C. All fire alarm junction box covers to be red.

3.4 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. All wiring shall be run in conduit.

3.5 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to elevator-shaft smoke/heat dampers.
2. Alarm-initiating connection to elevator recall system and components.
3. Supervisory connections at valve supervisory switches.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and the Engineer.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.12 TESTING

A. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

B. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

C. Open initiating device circuits and verify that the trouble signal actuates.

D. Open and short signaling line circuits and verify that the trouble signal actuates.

E. Open and short notification appliance circuits and verify that trouble signal actuates.

F. Ground all circuits and verify response of trouble signals.

G. Check presence and audibility of tone at all alarm notification devices.

H. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

I. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

J. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.13 FINAL INSPECTION

A. At the final inspection, a minimum NICET Level II technician shall demonstrate that the system functions properly in every respect.

3.14 INSTRUCTIONS

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided,

B. The contractor or installing dealer shall provide a user manual indicating "Sequence of Operation."

END OF SECTION 283111

MAINE TURNPIKE AUTHORITY

SPECIFICATIONS

PART V – APPENDICES

CONTRACT 2022.07

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
MM 34.7 TO MM 36.6

LIST OF APPENDICES

APPENDIX A

Asbestos Demolition / Renovation Impact Survey

Asbestos Demolition/Renovation Impact Survey

(LCC Project # 22-0341)

Prepared For:

Ralph Norwood
Project Manager
Maine Turnpike Authority
2360 Congress Street
Portland, Maine 04101

Email:
rnorwood@maineturnpike.com

Project Location:

348 North Street
Saco, Maine 04072

From:

Dana Codrey
Project Manager
Lakeside Concrete Cutting, Inc
12 Railroad Street
Newport, Maine 04953
207-773-1276

June 1, 2022

June 1, 2022

Re: Asbestos Demolition Impact Assessment

Dear Ralph:

Lakeside Concrete Cutting and Abatement Professionals is providing you with the asbestos bulk testing results for the samples collected from readily accessible building materials that may be impacted by demolition/renovations activities at **348 North Street, Saco, ME 04072.**

LCC collected twenty-four bulk samples suspect building material that may be impacted by renovations/demolition activities. The building materials collected included multiple types of flooring, wall materials, ceiling materials, roofing materials, and other miscellaneous suspect materials within the boundaries of the complex. The MDEP Chapter 425 and USEPA has minimum sampling requirements for asbestos building material investigations. The requirements are as follows.

Surfacing materials; sprayed or applied by trowel and include fireproofing materials and various plasters. At least three bulk samples of surfacing materials were collected from each homogeneous area that was less than 1,000-square feet. Five bulk samples were collected for areas 1,000 to 5,000-square feet, and seven bulk samples were collected for area greater than 5,000-square feet.

Thermal system insulation: including boiler cover, pipe cover, and duct insulation were assessed. The materials were either assumed to be asbestos containing or were sampled as follows; At least three bulk samples of thermal system insulation from each homogenous area or at least one bulk sample from each homogeneous patched area if the section is less than six linear or square feet.

Miscellaneous ACM: includes a variety of ceiling tiles, floor tiles, and gypsum board. Sample quantities for miscellaneous ACM follow the same requirements as for the two previously mentioned ACM types.

The bulk samples were collected with standard sampling protocols, properly packaged, maintained and delivered to Northeast Laboratory for analysis by Polarized Light Microscopy (PLM) specific to asbestos content by volume.

LCC collected sample groups of suspect homogenous building materials from the structure at the site that will likely be impacted by demolition/renovation activities. **The bulk sample analyses indicates that the structure has NO regulated asbestos containing building materials.**

LAKESIDE
CONCRETE CUTTING &
ABATEMENT PROFESSIONALS

The attached bulk sample analyses indicates that there are no detectable levels of asbestos in the building materials tested.

Should any additional suspect building materials be found during any of the demolition/renovation work, the work should immediately stop until additional sampling can be conducted.

We appreciate the opportunity to service your asbestos testing needs, should you require further bulk or air quality sampling please feel free to contact us at any time.

Very truly,

Dana Codrey
Project Manager

ASBESTOS SAMPLING

Project # 22-0341
Date: 5/11/2022

Client: Maine Turnpike Authority
3360 Congress St.
Portland, Maine

Location: 348 North Street
Saco, Maine

Sample ID #	Sample Location/Description	Asbestos %	Non-Asbestos Fibrous Material %	Non-Fibrous Material %
B-1	Unit #1; **Popcorn Ceiling**; White	None Detected	65%	35%
B-2	Unit #1; **Popcorn Ceiling**; White	None Detected	60%	40%
B-3	Unit #1; **Popcorn Ceiling**; White	None Detected	65%	35%
B-4	Unit #2; Bath, **Flooring**; Tan	None Detected	5%	21%
B-5	Unit #2; Bath, **Flooring**; Tan	None Detected	5%	14%
B-6	Unit #2; Bath, **Flooring**; Tan	None Detected	3%	14%
B-7	Unit #2; Bath, **Flooring**; Tan	None Detected	2%	12%
B-8	Unit #2; Bath, **Flooring**; Tan	None Detected	3%	12%
B-9	Unit #2; Bath, **Flooring**; Tan	None Detected	10%	22%
B-10	Unit #2; Kitchen; **Flooring**; Tan	None Detected	11%	42%

Lab: Northeast Laboratory Services #LB-0082

Analysis Method: EPA Method 600/R-93/116
Polarized Light Microscopy

Sampled By: Dana Codrey

ASBESTOS SAMPLING

Project # 22-0341
Date: 5/11/2022

Client: Maine Turnpike Authority
3360 Congress St.
Portland, Maine

Location: 348 North Street
Saco, Maine

Sample ID #	Sample Location/Description	Asbestos %	Non-Asbestos Fibrous Material %	Non-Fibrous Material %
B-11	Unit #2; Kitchen; **Flooring**; Tan	None Detected	9%	36%
B-12	Unit #2; Kitchen; **Flooring**; Tan	None Detected	8%	31%
B-13	Unit #2; Entry; **Flooring**; Red	None Detected	3%	59%
B-14	Unit #2; Entry; **Flooring**; Red	None Detected	6%	54%
B-15	Unit #2; Entry; **Flooring**; Red	None Detected	11%	61%
B-16	Unit #1; Kitchen; **Flooring**; Tan	None Detected	6%	58%
B-17	Unit #1; Kitchen; **Flooring**; Tan	None Detected	9%	48%
B-18	Unit #1; Kitchen; **Flooring**; Tan	None Detected	10%	38%
B-19	Unit # 1; Bath; **Flooring**; Tan	None Detected	7%	19%
B-20	Unit # 1; Bath; **Flooring**; Tan	None Detected	14%	27%

Lab: Northeast Laboratory Services #LB-0082

Analysis Method: EPA Method 600/R-93/116
Polarized Light Microscopy

Sampled By: Dana Codrey

ASBESTOS SAMPLING

Project # 22-0341
Date: 5/11/2022

Client: Maine Turnpike Authority
3360 Congress St.
Portland, Maine

Location: 348 North Street
Saco, Maine

Sample ID #	Sample Location/Description	Asbestos %	Non-Asbestos Fibrous Material %	Non-Fibrous Material %
B-21	Unit # 1; Bath; **Flooring**; Tan	None Detected	25%	37%
B-22	Unit #1; Bath; **Flooring**; Black	None Detected	None Detected	4%
B-23	Unit #1; Bath; **Flooring**; Black	None Detected	None Detected	7%
B-24	Unit #1; Bath; **Flooring**; Black	None Detected	None Detected	4%

Lab: Northeast Laboratory Services #LB-0082

Analysis Method: EPA Method 600/R-93/116
Polarized Light Microscopy

Sampled By: Dana Codrey

APPENDIX B

Subsurface Wastewater Disposal System Application

SUBSURFACE WASTEWATER DISPOSAL SYSTEM APPLICATION

Maine Dept.Health & Human Services
Div. Environmental Health, 11 SHS
(207) 287-2070 Fax: (207) 287-4172

PROPERTY LOCATION

City, Town, or Plantation	SACO
Street or Road	Buxton Road and I-95 South
Subdivision, Lot #	N/A

OWNER/APPLICANT INFORMATION

Name (last, first, MI) Maine Turnpike Authority c/o: Ralph Norwood — Owner ☐ Applicant ☒

Mailing Address of Owner/Applicant	2360 Congress St.
	Portland, ME 04012
Daytime Tel. #	(207) 482-8348

OWNER OR APPLICANT STATEMENT

I state and acknowledge that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department and/or Local Plumbing Inspector to deny a Permit.

Signature of Owner or Applicant _____ Date _____

>> CAUTION: LPI APPROVAL REQUIRED <<

Town/City _____ Permit # _____

Date Permit Issued ___/___/___ Fee: $_____ Double Fee Charged ☐

_____ L.P.I. # _____

Local Plumbing Inspector Signature

Fee: $_____state min fee $_____Locally adopted fee

Copy: ☐ Owner ☐ Town [ ] State

The Subsurface Wastewater Disposal System ***shall not*** be installed until a Permit is issued by the Local Plumbing Inspector. The Permit shall authorize the owner or installer to install the disposal system in accordance with this application and the Maine Subsurface Wastewater Disposal Rules.

Municipal Tax Map # _____ Lot # _____

CAUTION: INSPECTION REQUIRED

I have inspected the installation authoirzed above and found it to be in compliance with the Subsurface Wastewater Disposal Rules Application. _____ (1st) date approved

Local Plumbing Inspector Signature _____ (2nd) date approved

PERMIT INFORMATION

TYPE OF APPLICATION

☒ 1. First Time System
☐ 2. Replacement System
Type replaced: _____
Year installed: _____
☐ 3. Expanded System
☐ a. Minor Expansion
☐ b. Major Expansion
☐ 4. Experimental System
☐ 5. Seasonal Conversion

THIS APPLICATION REQUIRES

☒ 1. No Rule Variance
☐ 2. First Time System Variance
☐ a. Local Plumbing Inspector Approval
☐ b. State & Local Plumbing Inspector Approval
☐ 3. Replacement System Variance
☐ a. Local Plumbing Inspector Approval
☐ b. State & Local Plumbing Inspector Approval
☐ 4. Minimum Lot Size Variance
☐ 5. Seasonal Conversion Permit

DISPOSAL SYSTEM COMPONENTS

☒ 1. Complete Non-engineered System
☐ 2. Primitive System (graywater & alt. toilet)
☐ 3. Alternative Toilet, specify: _____
☐ 4. Non-engineered Treatment Tank (only)
☐ 5. Holding Tank, _____ gallons
☐ 6. Non-engineered Disposal Field (only)
☐ 7. Separated Laundry System
☐ 8. Complete Engineered System (2000 gpd or more)
☐ 9. Engineered Treatment Tank (only)
☐ 10. Engineered Disposal Field (only)
☐ 11. Pre-treatment, specify: _____
☐ 12. Miscellaneous Components

SIZE OF PROPERTY

N/A ☐ SQ. FT. ☐ ACRES

SHORELAND ZONING

☐ Yes ☒ No

DISPOSAL SYSTEM TO SERVE

☐ 1. Single Family Dwelling Unit, No. of Bedrooms: ____
☐ 2. Multiple Family Dwelling, No. of Units: _____
☒ 3. Other: _____ (specify)

Current Use ☐ Seasonal ☐ Year Round ☒ Undeveloped

TYPE OF WATER SUPPLY

☐ 1. Drilled Well ☐ 2. Dug Well ☐ 3. Private
☒ 4. Public ☐ 5. Other

DESIGN DETAILS (SYSTEM LAYOUT SHOWN ON PAGE 3)

TREATMENT TANK

☒ 1. Concrete
☒ a. Regular
☐ b. Low Profile
☐ 2. Plastic
☐ 3. Other: _____
CAPACITY: 1,000 GAL.

DISPOSAL FIELD TYPE & SIZE

☐ 1. Stone Bed ☐ 2. Stone Trench
☒ 3. Proprietary Device concrete chamber
☒ a. cluster array ☐ c. Linear
☐ b. regular load ☒ d. H-20 load
☐ 4. Other: _____
SIZE: 594 ☒ sq. ft. ☐ lin. ft.

GARBAGE DISPOSAL UNIT

☒ 1. No ☐ 2. Yes ☐ 3. Maybe
If Yes or Maybe, specify one below:
☐ a. multi-compartment tank
☐ b. ___ tanks in series
☐ c. increase in tank capacity
☐ d. Filter on Tank Outlet

DESIGN FLOW

180 gallons per day
BASED ON:
1. Table 4A (dwelling unit(s))
2. Table 4C (other facilities)
SHOW CALCULATIONS for other facilites
13 employees @ 12 GPD each = 156
3. Section 4G (meter readings)
ATTACH WATER METER DATA

SOIL DATA & DESIGN CLASS

PROFILE 3 / CONDITION C
at Observation Hole # AB 01
Depth 16 "
of Most Limiting Soil Factor

DISPOSAL FIELD SIZING

☐ 1. Small---2.0 sq. ft. / gpd
☐ 2. Medium---2.6 sq. ft. / gpd
☒ 3. Medium---Large 3.3 sq. f.t / gpd
☐ 4. Large---4.1 sq. ft. / gpd
☐ 5. Extra Large---5.0 sq. ft. / gpd

EFFLUENT/EJECTOR PUMP

☒ 1. Not Required
☐ 2. May Be Required
☐ 3. Required
Specify only for engineered systems:
DOSE: _____ gallons

LATITUDE AND LONGITUDE

at center of disposal area
Lat. 43 d 31 m 18.977 s
Lon. 70 d 27 m 41.911 s
if g.p.s, state margin of error: 3 feet

SITE EVALUATOR STATEMENT

I certify that on March 22, 2022 (date) I completed a site evaluation on this property and state that the data reported are accurate and that the proposed system is in compliance with the State of Maine Subsurface Wastewater Disposal Rules (10-144 CMR 241).

Site Evaluator Signature	371 SE #	2022-04-13 Date
Rodney D. Kelshaw Site Evaluator Name Printed	(207) 944-6776 Telephone Number	rodney@flycatcherllc.com E-mail Address

STATE OF MAINE · RODNEY D. KELSHAW · No. 371 · LICENSED SITE EVALUATOR

Note: Changes to or deviations from the design should be confirmed with the Site Evaluator.

SUBSURFACE WASTEWATER DISPOSAL SYSTEM APPLICATION

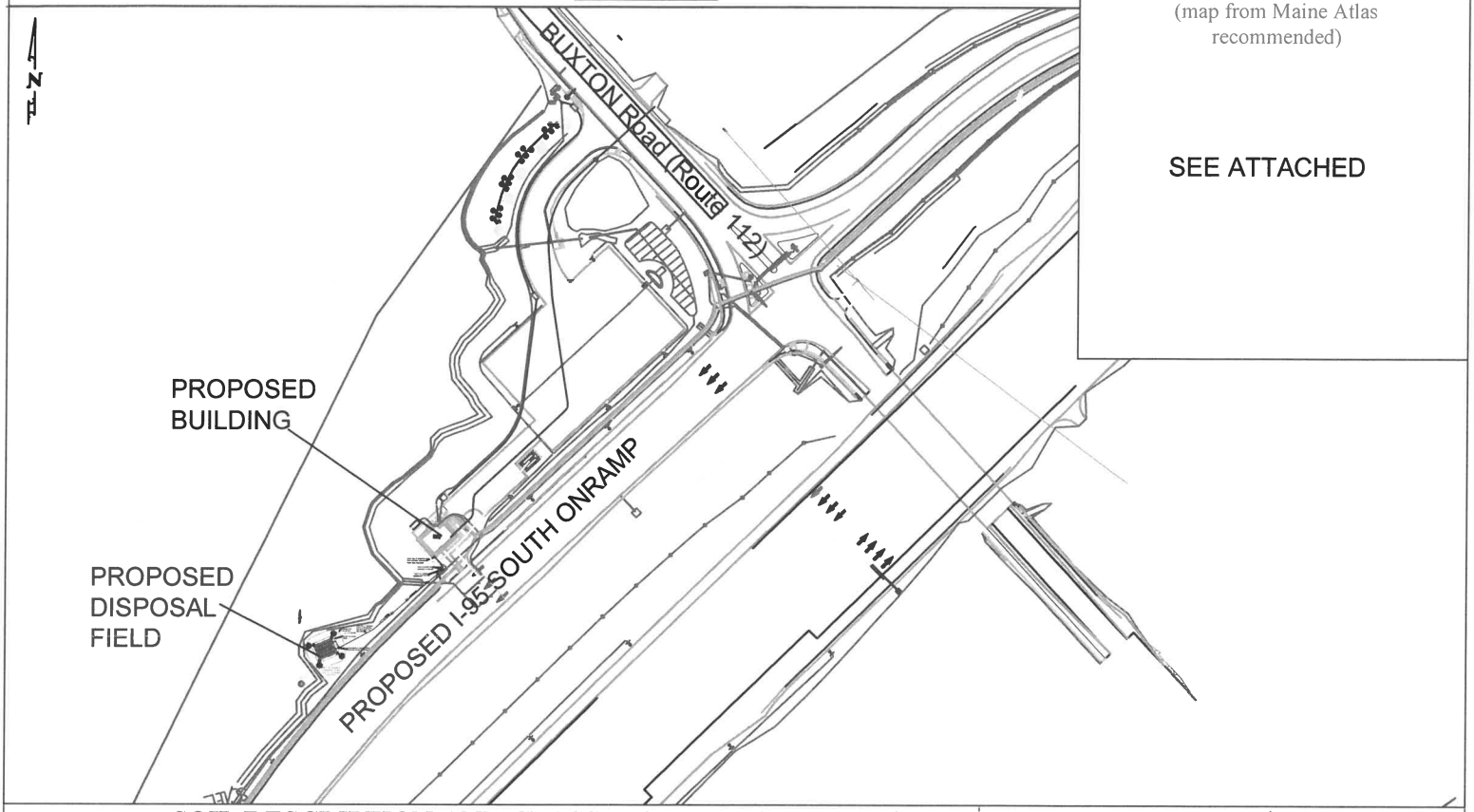
Department of Health & Human Services
Division of Environmental Health
(207) 287-2070 Fax: (207) 287-4172

Town, City, Plantation	Street, Road, Subdivision	Owner's Name
Saco	Buxton Road and I-95 South	Maine Turnpike Authority

SITE PLAN Scale 1" = 200 ft. or as shown

SITE LOCATION PLAN
(map from Maine Atlas recommended)

SEE ATTACHED



SOIL DESCRIPTION AND CLASSIFICATION (Location of Observation Holes Shown Above)

Observation Hole AB 01 ☒ Test Pit ☐ Boring
0 " Depth of Organic Horizon Above Mineral Soil

Depth Below Mineral Soil Surface (inches)	Texture	Consistency	Color	Mottling
0–10	l	VFR	7.5YR 2.5/3	none observed
10–20	grl	FR	10YR 5/6 2.5Y 5/4	
20–30		FI	10YR 4/6 5Y 5/6	2% & saturation
30–40		LOI 36"		
40–50				

Soil Classification	Slope	Limiting Factor	
3 Profile / C Condition	2.4 - 6 %	16 "	[X] Ground Water [ ] Restrictive Layer [ ] Bedrock [ ] Pit Depth

Observation Hole TP 02 ☒ Test Pit ☐ Boring
0 " Depth of Organic Horizon Above Mineral Soil

Depth Below Mineral Soil Surface (inches)	Texture	Consistency	Color	Mottling
0–10	l	VFR	7.5YR 2.5/3	none observed
10–20	grl	FR	10YR 5/6 2.5Y 5/4	
20–30		FI	10YR 4/6 5Y 5/6	2% & saturation
30–40		LOI 36"		
40–50				

STATE OF MAINE
RODNEY D. KELSHAW
No. 371
LICENSED SITE EVALUATOR

Soil Classification	Slope	Limiting Factor	
3 Profile / C Condition	2.4 - 6 %	18 "	[X] Ground Water [ ] Restrictive Layer [ ] Bedrock [ ] Pit Depth

Site Evaluator Signature | 371 SE # | 2022-04-13 Date

SUBSURFACE WASTEWATER DISPOSAL SYSTEM APPLICATION

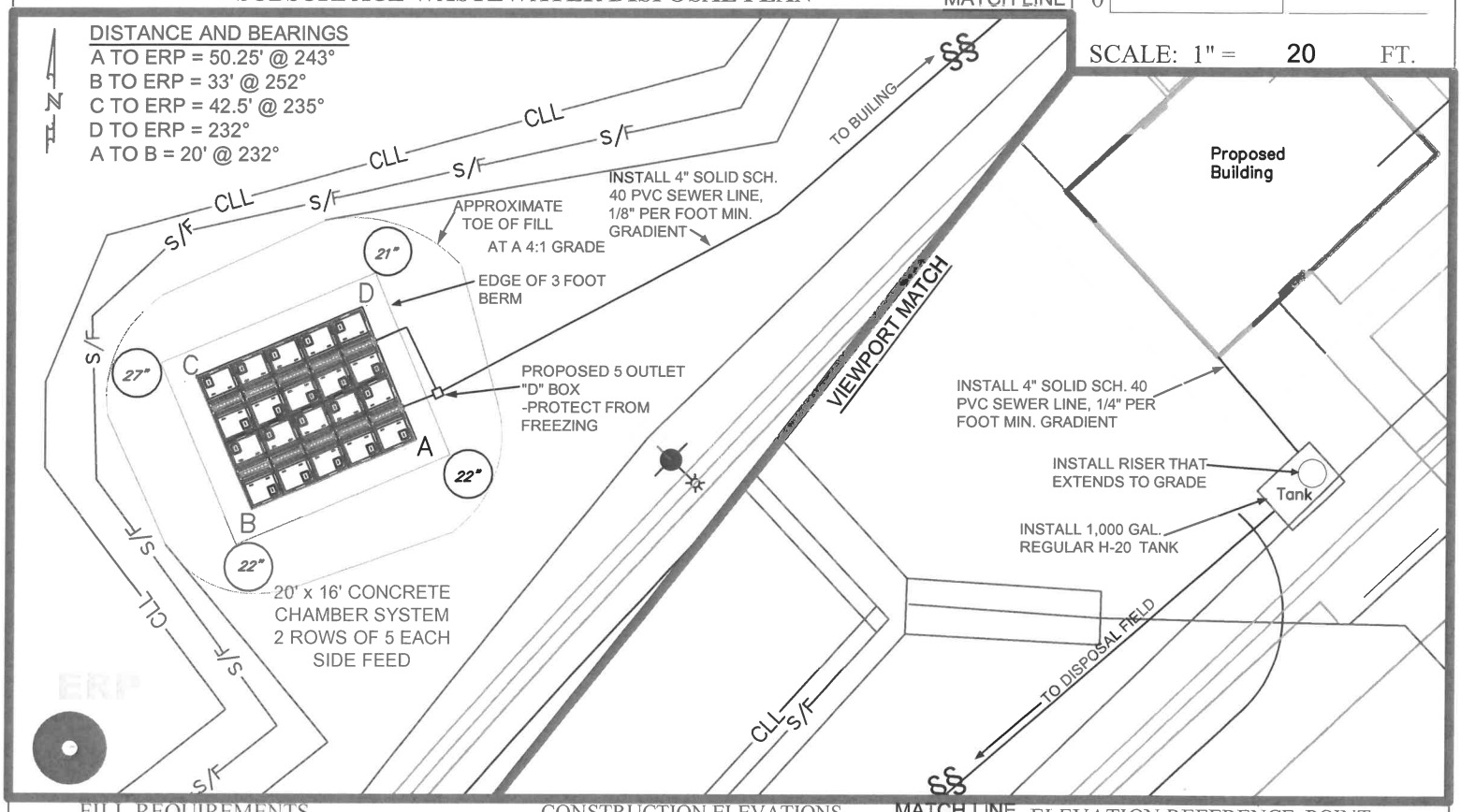
Department of Health & Human Services
Division of Environmental Health
(207) 287-2070 Fax: (207) 287-4172

Town, City, Plantation	Street, Road, Subdivision	Owner's Name
Saco	Buxton Road and I-95 South	Maine Turnpike Authority

SUBSURFACE WASTEWATER DISPOSAL PLAN

MATCH LINE 0

SCALE: 1" = 20 FT.

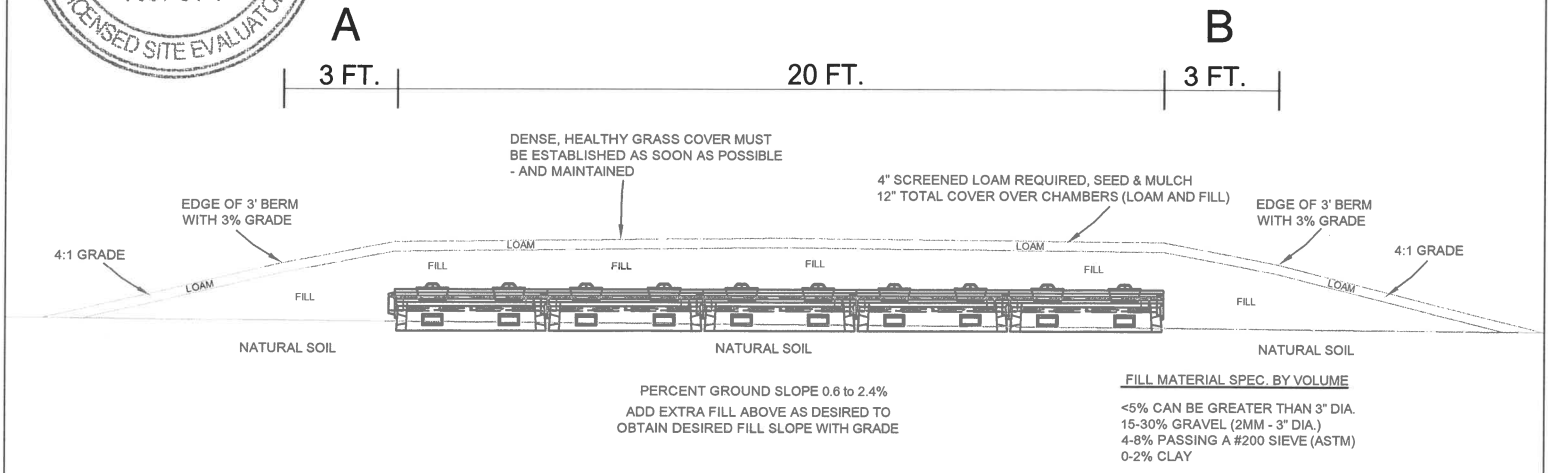


FILL REQUIREMENTS		CONSTRUCTION ELEVATIONS	MATCH LINE	ELEVATION REFERENCE POINT	
Depth of Fill (Upslope)	22"	Finished Grade Elevation	37.5" (96.9)	Location & Description	nail w/ blue flag 26.5" high on 8" spruce
Depth of Fill (Downslope)	21 - 27"	Top of Distribution Pipe or Proprietary Device	49.5" (95.9)	Reference Elevation:	0.00'
		Bottom of Disposal Area	62.5" (94.8)		

STATE OF MAINE
RODNEY D. KELSHAW
No. 371
LICENSED SITE EVALUATOR

DISPOSAL AREA CROSS SECTION

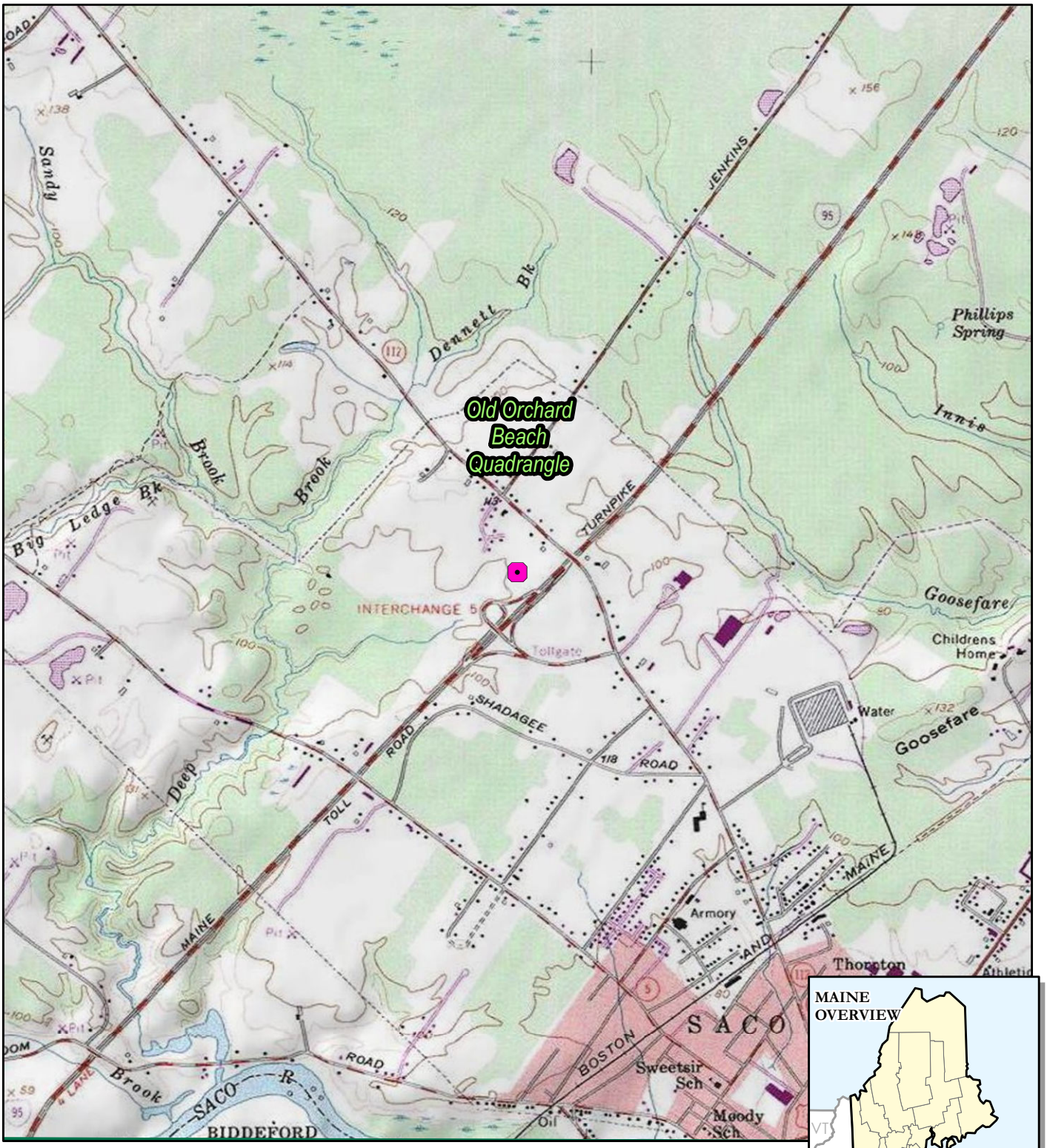
Scale
Horizontal 1" = 5 ft.
Vertical 1" = 5 ft.



PERCENT GROUND SLOPE 0.6 to 2.4%
ADD EXTRA FILL ABOVE AS DESIRED TO OBTAIN DESIRED FILL SLOPE WITH GRADE

FILL MATERIAL SPEC. BY VOLUME
<5% CAN BE GREATER THAN 3" DIA.
15-30% GRAVEL (2MM - 3" DIA.)
4-8% PASSING A #200 SIEVE (ASTM)
0-2% CLAY

Site Evaluator Signature	SE #	Date
	371	2022-04-13



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

Stantec

Flycatcher
LAND + SCIENCE + PEOPLE

PROJECT:

STANTEC
EXIT 36 INTERCHANGE IMPROVEMENTS
SACO, YORK COUNTY, MAINE

LEGEND:

PROPOSED SEPTIC SYSTEM LOCATION
USGS 7.5-MINUTE QUADRANGLE BOUNDARY

DRAWN BY:	D. KENWORTHY
CHECKED BY:	R. KELSHAW
MONTH:	APRIL
YEAR:	2022
PROJ. NO.:	21L
CLIENT:	STANTEC

FIGURE 1

D:\Flycatcher\Projects\Stantec\Stantec_MTA36_Septic_Fig1_USGS_8x11P.mxd -- Saved By: JAKEN on 4/11/2022, 03:31:21 AM

American Concrete Industries

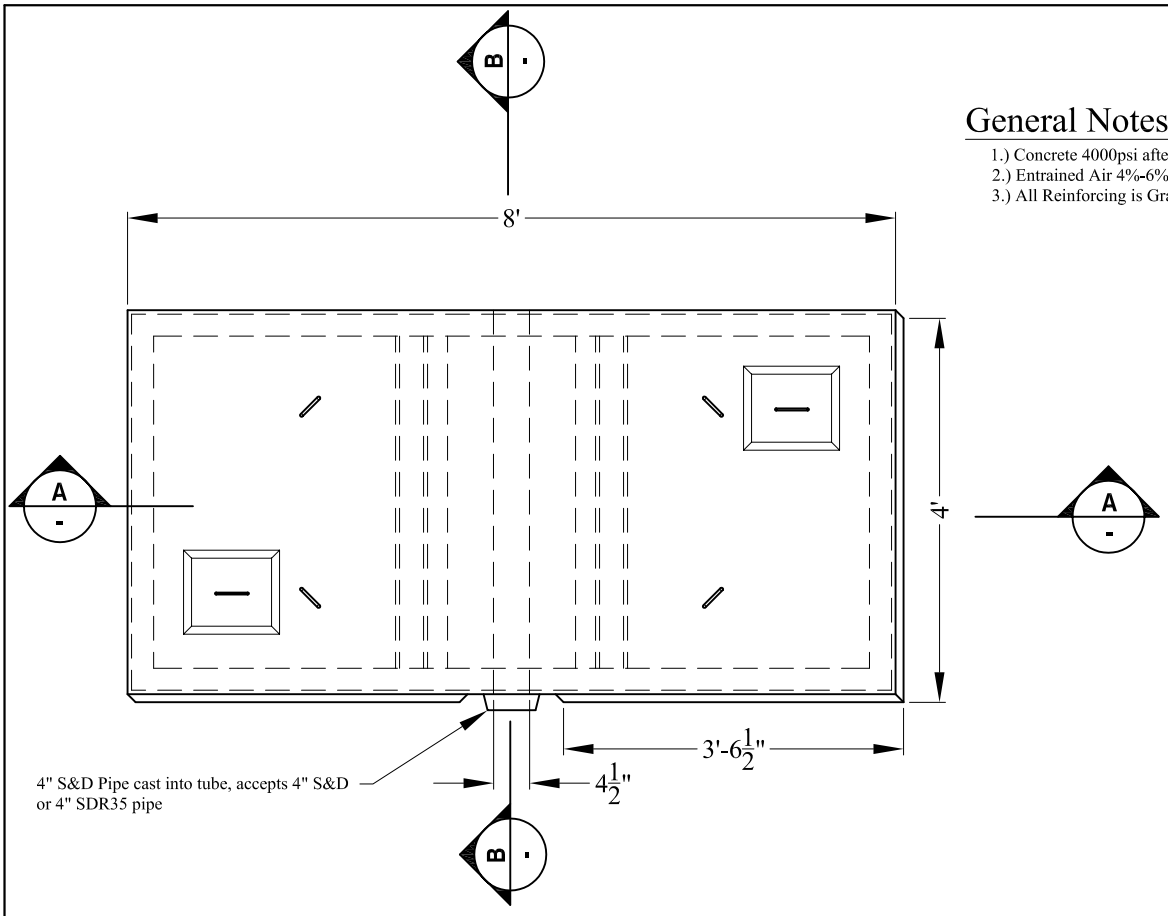
4' X 8' SF Flow Diffuser

Catalog Section: Residential. Leaching Chambers

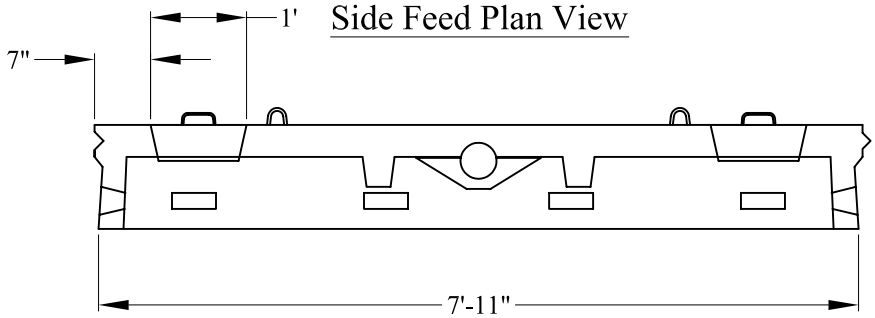
Layout Name:

General Notes

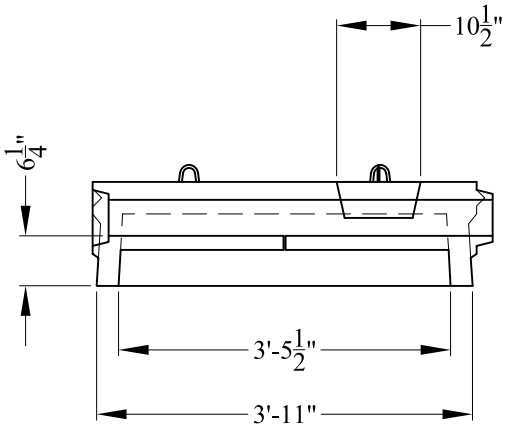
1.) Concrete 4000psi after 28 days
2.) Entrained Air 4%-6%
3.) All Reinforcing is Grade 60



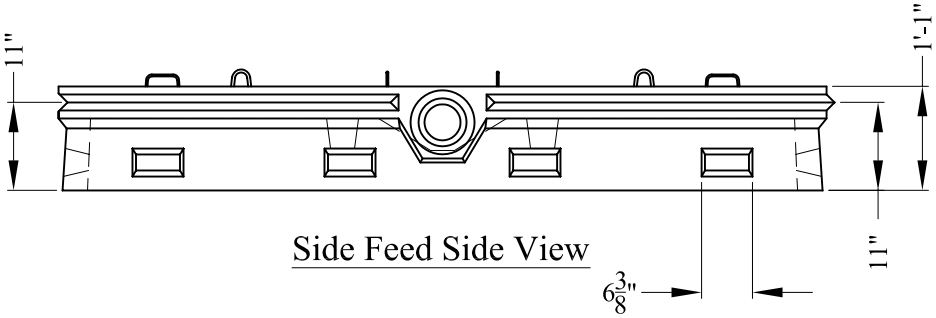
Side Feed Plan View



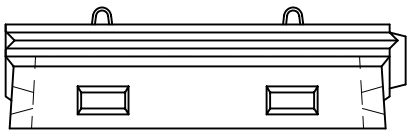
Side Feed Section "A"-"A"



Side Feed End View
Section "B"-"B"



Side Feed Side View



Side Feed End View

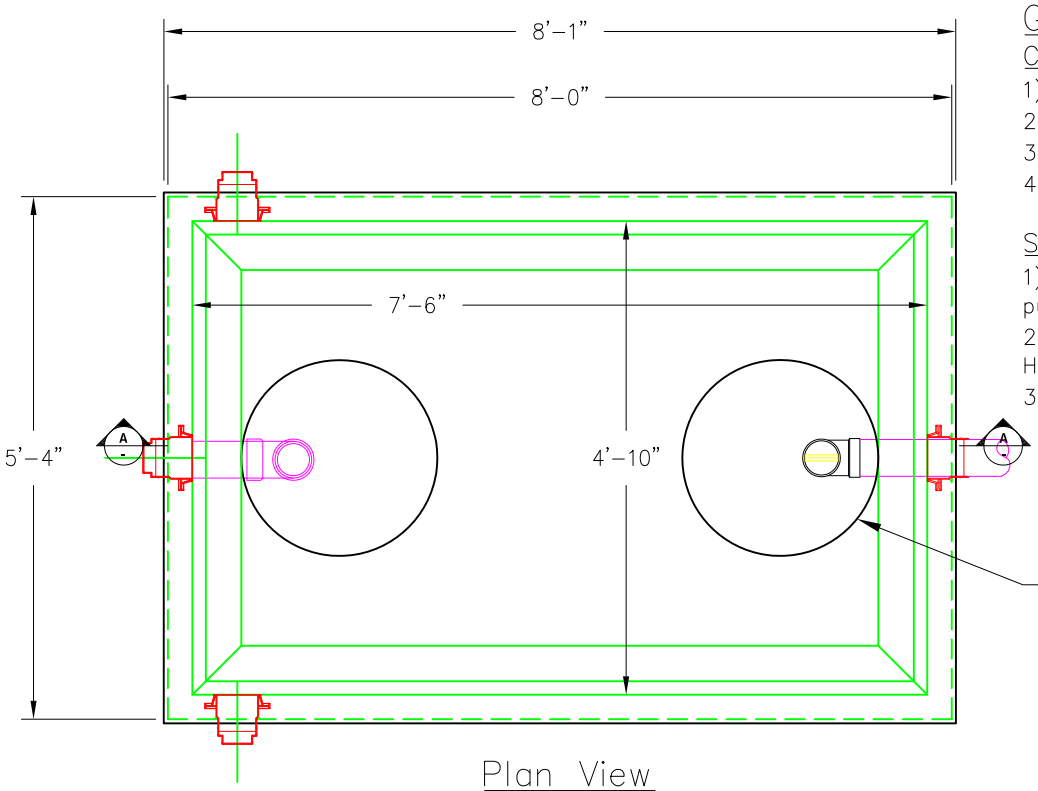
American Concrete Industries
1022 Minot Ave. Auburn, ME / 1717 Stillwater Ave., Veazie ME
Tel: 207-784-1388 / Tel: 207-947-8334

Drawing Name: 4' X 8' SF Flowdiffuser
Latest Revision: Date :
Drawing Date: 10/29/2002

American Concrete Industries

1000 Gallon Regular H-20 Tank

Catalog Section: Residential.Tanks
Layout Name: Catalog Vertical



Plan View

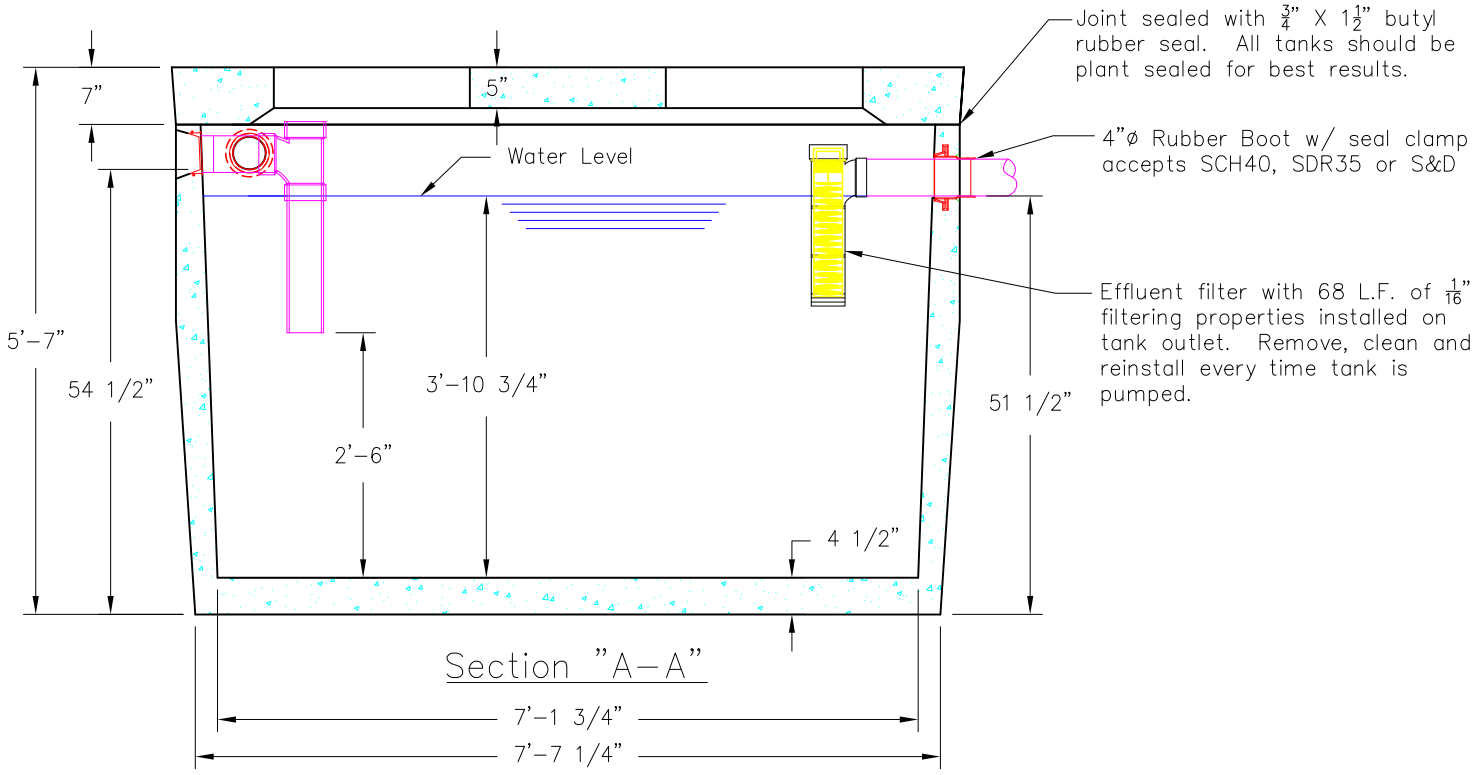
General Notes:

Concrete Specifications:

1) 5000 psi @ 28 Days
2) 4%-6% Entrained Air
3) Tank Penatrations are integrally cast
4) Designed for H-20 Wheel Loading

Site Information:

1) Tanks Should be pumped every 3-5 years
2) Requires grade rings to grade with H-20 Frame & Covers
3) Fill Requirements: 12"-60"



Section "A-A"

1000 Gallon Top Seam Septic Tank (H-20)

Item # 2134 Weight: 9900 lbs.

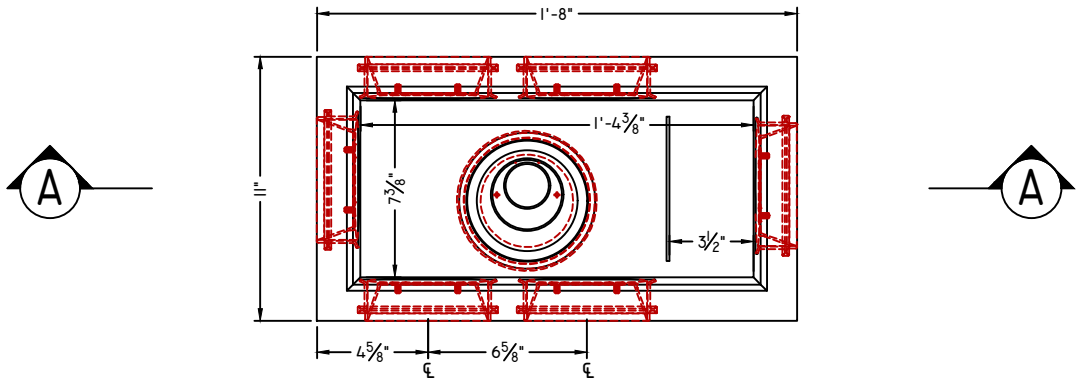
American Concrete Industries
1022 Minot Ave. Auburn, ME / 1717 Stillwater Ave., Veazie ME
Tel: 207-784-1388 / Tel: 207-947-8334

Drawing Name: 1000 Gallon Regular H-20
Latest Revision: 0.0 Date :08/12/2003
Drawing Date: 04/03/2001

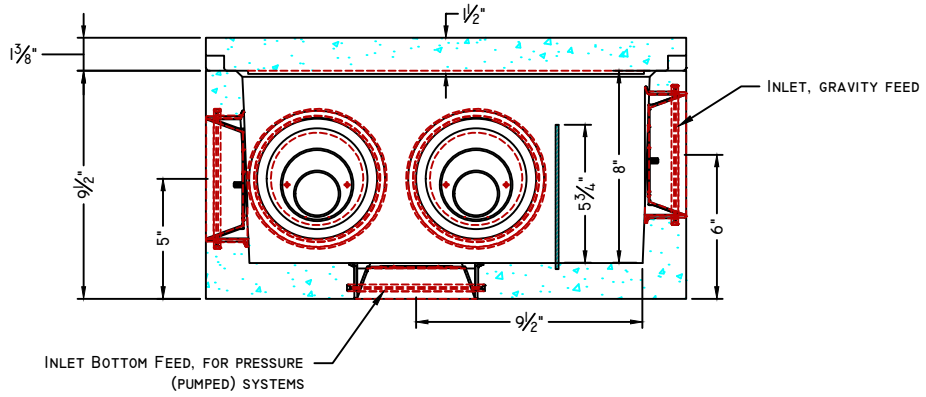
American Concrete Industries

5 Outlet Distribution Box (D-Box)

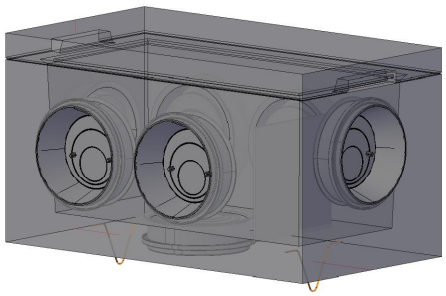
WWW.AMERICANCONCRETE.COM
1717 Stillwater Ave.
Veazie, ME. 04401
Tel: (207) 947-8334
Fax: (207) 947-3580



Plan View
(without Cover)



Section A-A



Conceptual View
Scale: NTS

Manufacturing Notes

1.1. Concrete Compressive Strength: 4,000psi @ 28 Days
1.2. Air Entrainment: 4-6%
1.3. Grade 60 Reinforcement & Structural fiber reinforced
1.4. NEVER use septic cleaning agents
1.5. Designed for pedestrian load rating only
1.6. All pipe seal penetrations are integrally cast
1.7. Flow Equalizers recommended for equal bed loading

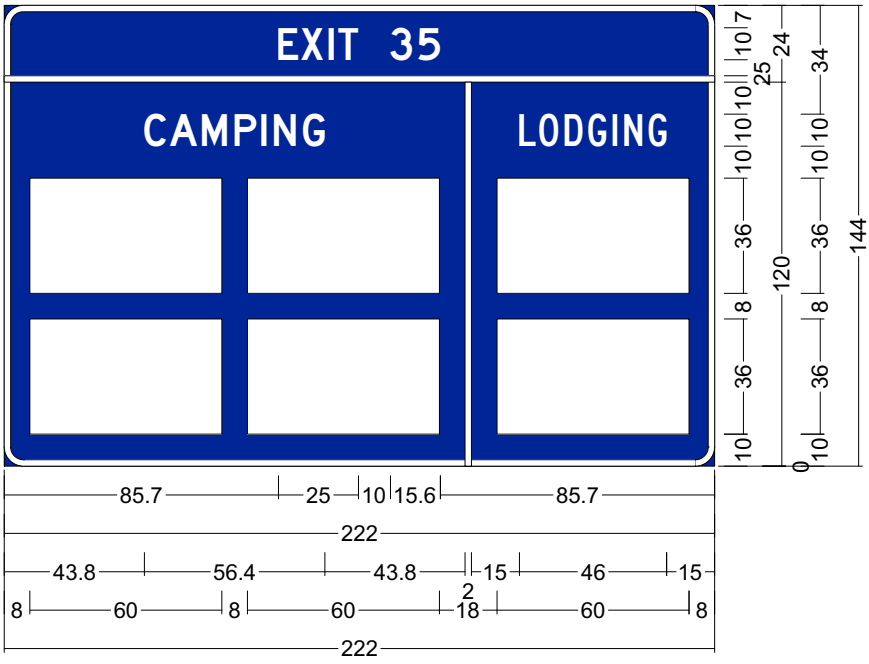
Physical Specifications:

Cover Weight:	**27 lbs**
Base Weight:	**73 lbs**
Total Weight:	**101 lbs**

Leaching Products | Distribution Boxes | 5-Outlet		Scale: 1½" = 1'-0" Unless otherwise noted	Revision #:
American Concrete Industries Catalog	Item#280030	Drawn Date: 4/18/2019 OLM	Revision Date:

APPENDIX C

Sign Text Layout Sheets



GS-2;
Quantity : 2;
6.0" Radius, 2.0" Border, White on, Blue;
"EXIT 35", D 2K; "CAMPING", D 2K; "LODGING", C 2K;
Table of letter and object lefts

E 85.7	X 92.9	I 101.4	T 104.5	3 120.7	5 129.5

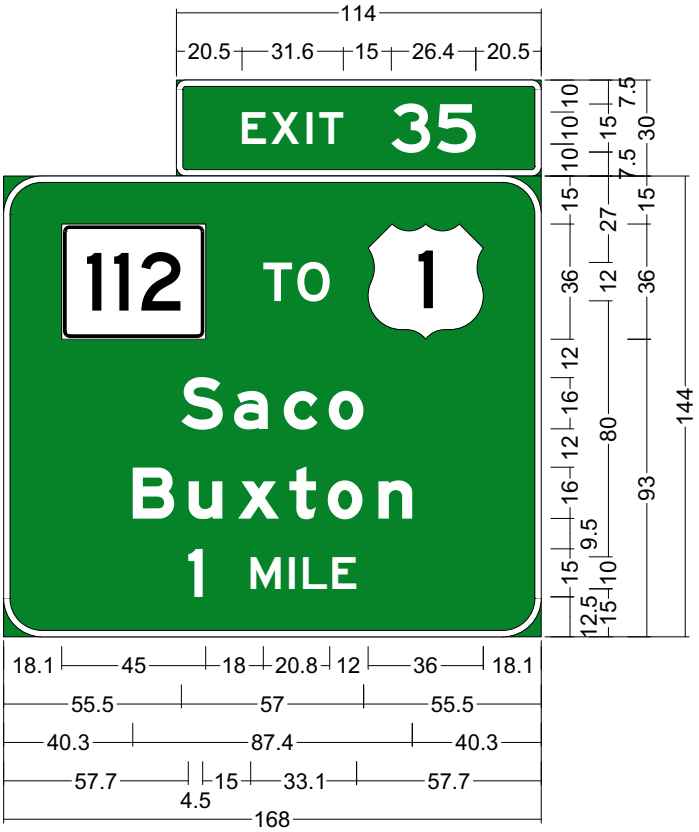
-0.0

C 43.8	A 51.9	M 61.9	P 72.1	I 80.4	N 84.4	G 93.4	144.0

L 161.0	O 167.3	D 175.2	G 182.6	I 190.2	N 193.8	G 201.4

8.0	76.0	154.0

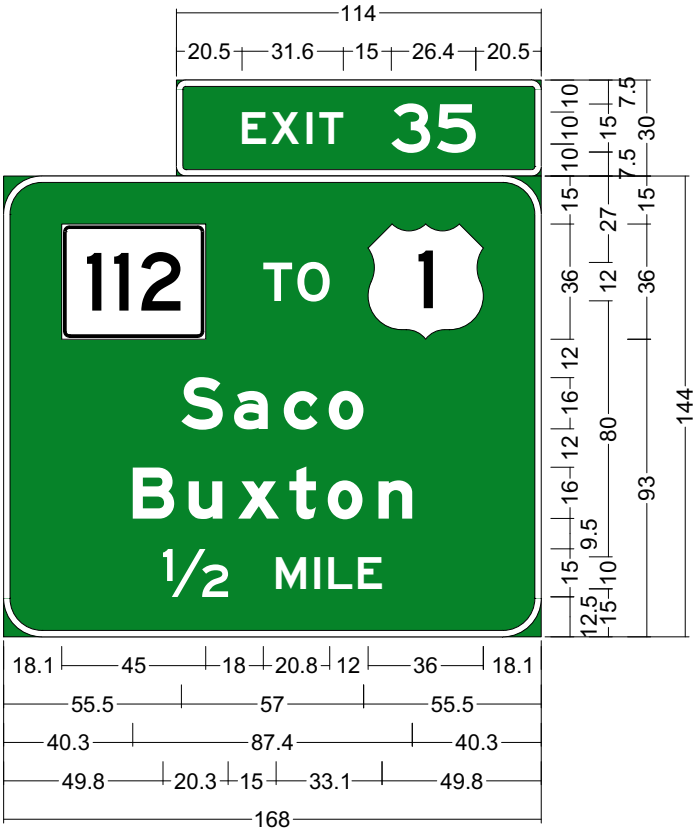
8.0	76.0	154.0



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-3;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Buxton", E Mod 2K;
"1 MILE", E 2K;
Table of letter and object lefts

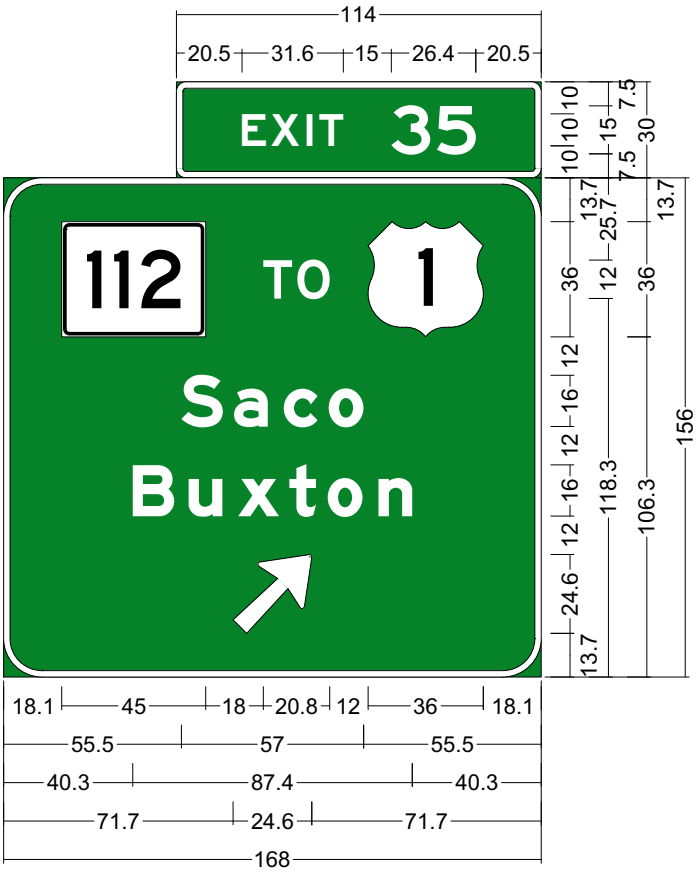
E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4
112 18.1	**T** 81.1	**O** 91.8	1 113.9		
S 55.5	**a** 72.0	**c** 87.5	**o** 101.6		
B 40.3	**u** 57.8	**x** 73.3	**t** 89.3	**o** 101.3	**n** 117.1
1 57.7	**M** 77.2	**I** 89.2	**L** 93.6	**E** 102.8	



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-5;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Buxton", E Mod 2K;
"½ MILE", E 2K;
Table of letter and object lefts

E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4
112 18.1	**T** 81.1	**O** 91.8	1 113.9		
S 55.5	**a** 72.0	**c** 87.5	**o** 101.6		
B 40.3	**u** 57.8	**x** 73.3	**t** 89.3	**o** 101.3	**n** 117.1
½ 49.8	**M** 85.1	**I** 97.1	**L** 101.5	**E** 110.7	



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-6;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Buxton", E Mod 2K;
Arrow Custom - 31.5" 45';
Table of letter and object lefts

E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4

112 18.1	**T** 81.1	**O** 91.8	1 113.9

S 55.5	**a** 72.0	**c** 87.5	**o** 101.6

B 40.3	**u** 57.8	**x** 73.3	**t** 89.3	**o** 101.3	**n** 117.1

↗ 71.7

E1-5P-36;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "36", E 2K;

GS-7;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; "Saco", E Mod 2K;
"Old Orchard", E Mod 2K; "Beach", E Mod 2K; "¼ MILE", E 2K;

12.0" Radius, 1.5" Border, 0.5" Indent, Black on, Yellow;
"EXIT", E Mod 2K; Down Arrow 22.0" 270'; "ONLY", E Mod 2K;
Table of letter and object lefts

E 20.3	**X** 29.4	**I** 40.5	**T** 44.4	**3** 66.9	**6** 81.6

62.3	**E** 119.3	**A** 132.1	**S** 145.6	**T** 156.7

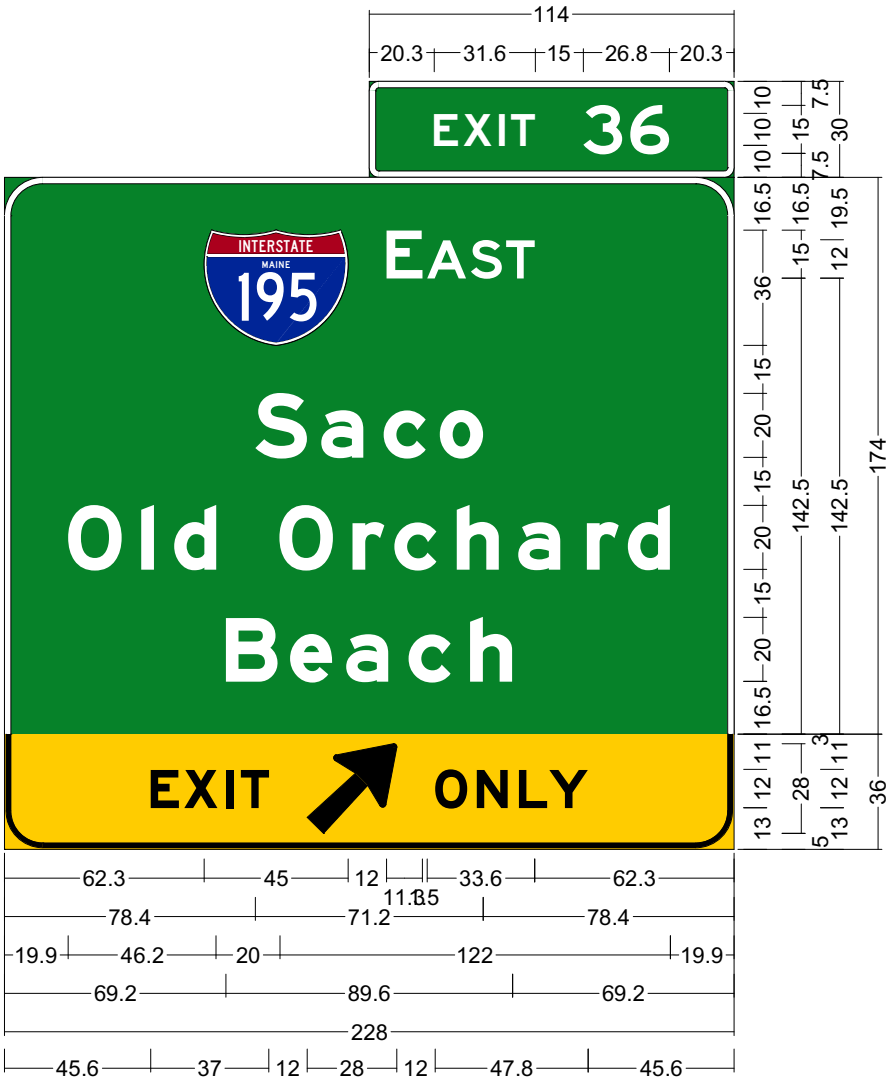
S 78.4	**a** 99.0	**c** 118.4	**o** 136.0

O 19.9	**l** 42.7	**d** 52.9	**O** 86.1	**r** 108.9	**c** 121.9	**h** 141.3	**a** 160.7	**r** 181.9	**d** 194.9

B 69.2	**e** 89.2	**a** 106.8	**c** 126.2	**h** 145.6

¼ 73.5	**M** 114.7	**I** 129.1	**L** 134.4	**E** 145.5

E 43.6	**X** 54.2	**I** 67.2	**T** 71.7	▼ 92.6	**O** 136.6	**N** 149.6	**L** 162.6	**Y** 172.2



E1-5P-36;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "36", E 2K;

GS-8;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; "Saco", E Mod 2K;
"Old Orchard", E Mod 2K; "Beach", E Mod 2K;

12.0" Radius, 1.5" Border, 0.5" Indent, Black on, Yellow;
"EXIT", E Mod 2K; Arrow Custom - 35.6" 45'; "ONLY", E Mod 2K;
Table of letter and object lefts

E 20.3	**X** 29.4	**I** 40.5	**T** 44.4	**3** 66.9	**6** 81.6

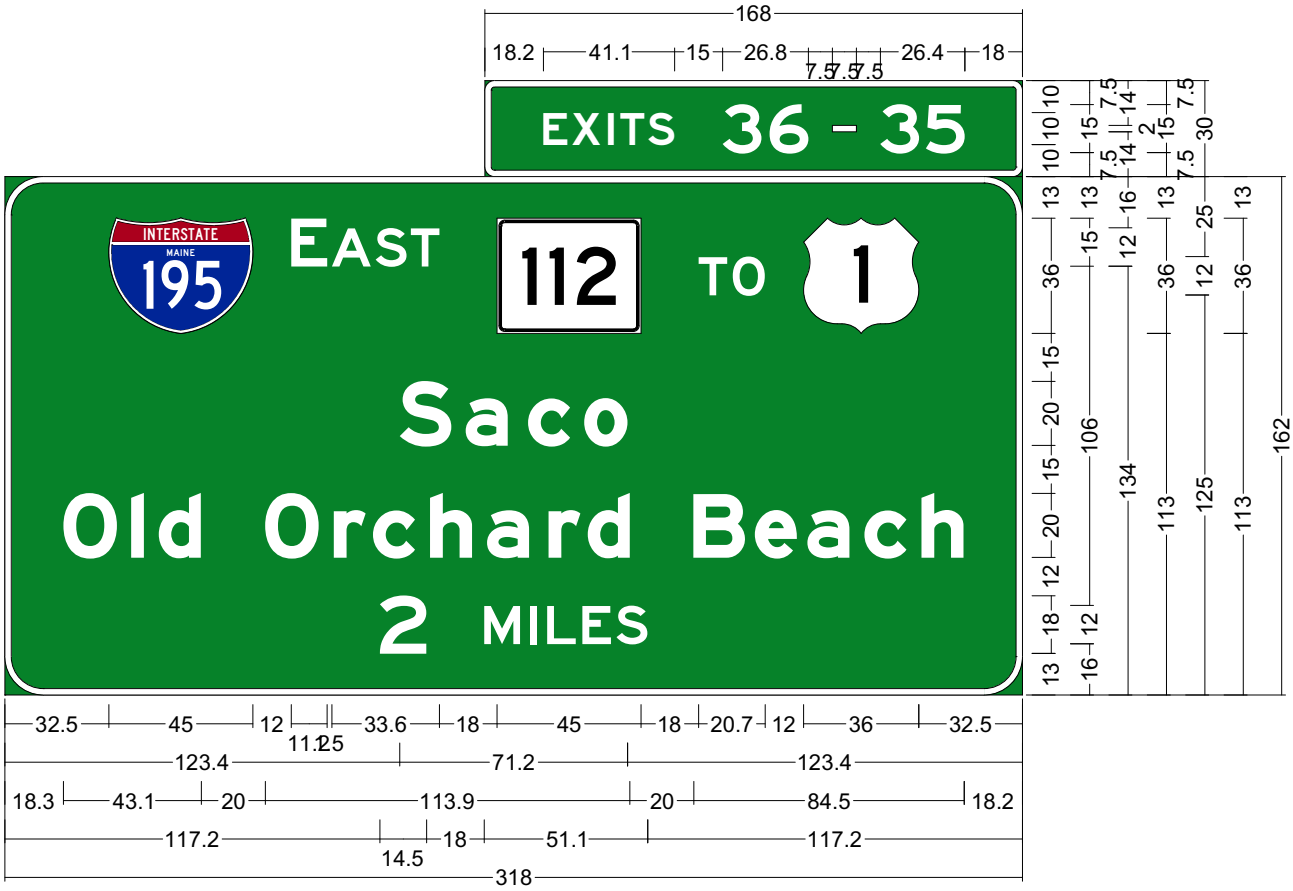
62.3	**E** 119.3	**A** 132.1	**S** 145.6	**T** 156.7

S 78.4	**a** 99.0	**c** 118.4	**o** 136.0

O 19.9	**l** 42.7	**d** 52.9	**O** 86.1	**r** 108.9	**c** 121.9	**h** 141.3	**a** 160.7	**r** 181.9	**d** 194.9

B 69.2	**e** 89.2	**a** 106.8	**c** 126.2	**h** 145.6

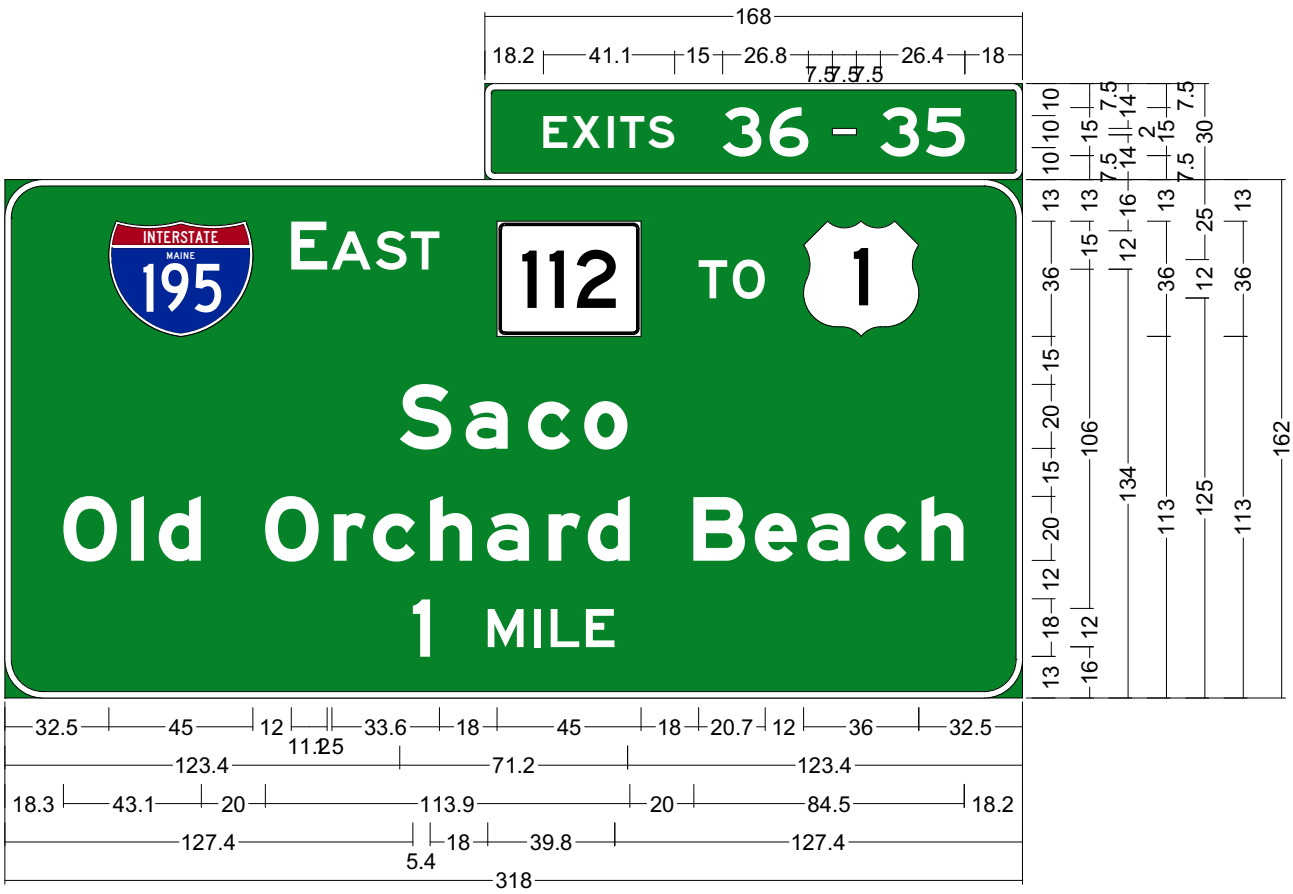
E 45.6	**X** 56.2	**I** 69.2	**T** 73.7	↗ 94.6	**O** 134.6	**N** 147.6	**L** 160.6	**Y** 170.2



E1-5P-36-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXITS", E 2K 120% spacing; "36", E 2K; "35", E 2K;

GS-9;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; State Highway 112 M1-5; "TO", E 2K; "Saco", E Mod 2K;
"Old Orchard Beach", E Mod 2K 75% spacing; "2 MILES", E 2K;
Table of letter and object lefts

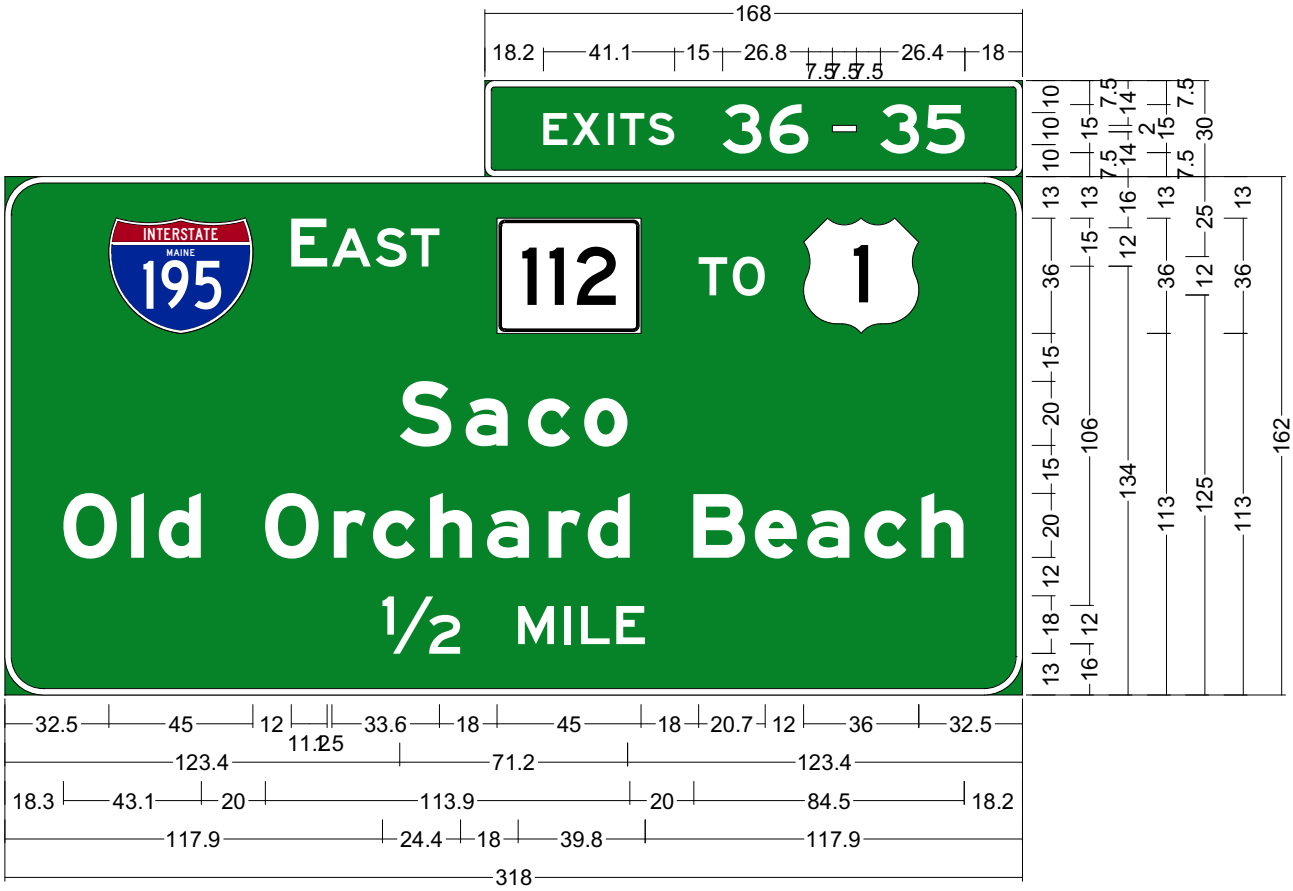
E 18.2	X 27.4	I 38.5	T 42.3	S 51.2	3 74.3	6 88.9	▬ 108.6	3 123.6	5 137.8
195 32.5	E 89.5	A 102.2	S 115.7	T 126.8	112 153.8	T 216.8	O 227.5	1 249.5	
S 123.4	a 144.0	c 163.4	o 181.0						
O 18.3	I 39.5	d 48.2	O 81.4	r 102.7	c 114.9	h 132.8	a 150.6	r 169.8	d 182.1	B 215.3	e 234.4	a 250.8	c 268.7	h 286.5
2 117.2	M 149.7	I 164.1	L 169.4	E 180.4	S 191.1				



E1-5P-36-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXITS", E 2K 120% spacing; "36", E 2K; "35", E 2K;

GS-11;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; State Highway 112 M1-5; "TO", E 2K; "Saco", E Mod 2K;
"Old Orchard Beach", E Mod 2K 75% spacing; "1 MILE", E 2K;
Table of letter and object lefts

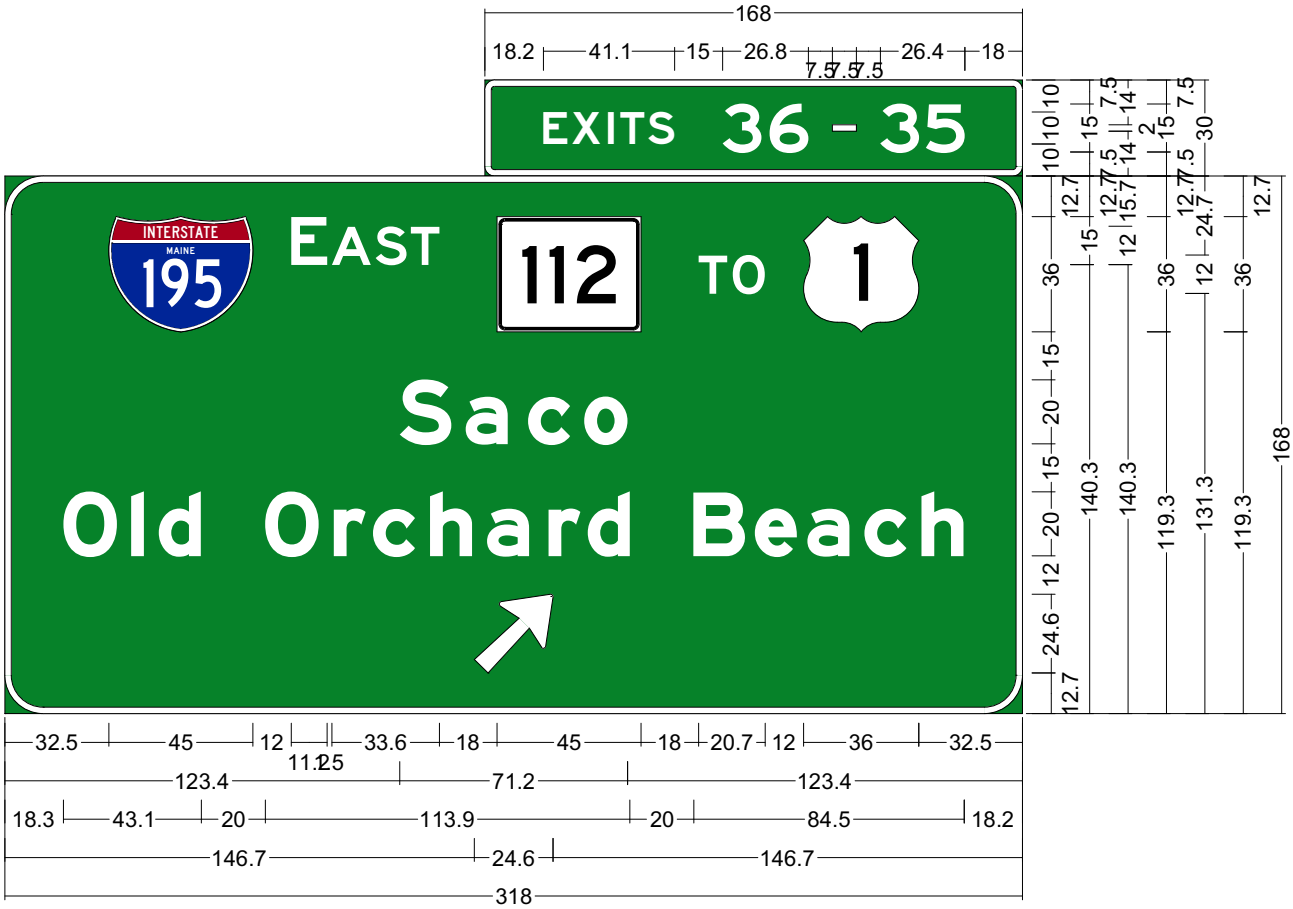
E 18.2	X 27.4	I 38.5	T 42.3	S 51.2	3 74.3	6 88.9	▬ 108.6	3 123.6	5 137.8
195 32.5	E 89.5	A 102.2	S 115.7	T 126.8	112 153.8	T 216.8	O 227.5	1 249.5	
S 123.4	a 144.0	c 163.4	o 181.0						
O 18.3	I 39.5	d 48.2	O 81.4	r 102.7	c 114.9	h 132.8	a 150.6	r 169.8	d 182.1	B 215.3	e 234.4	a 250.8	c 268.7	h 286.5
1 127.4	M 150.8	I 165.2	L 170.5	E 181.6					



E1-5P-36-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXITS", E 2K 120% spacing; "36", E 2K; "35", E 2K;

GS-12;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; State Highway 112 M1-5; "TO", E 2K; "Saco", E Mod 2K;
"Old Orchard Beach", E Mod 2K 75% spacing; "½ MILE", E 2K;
Table of letter and object lefts

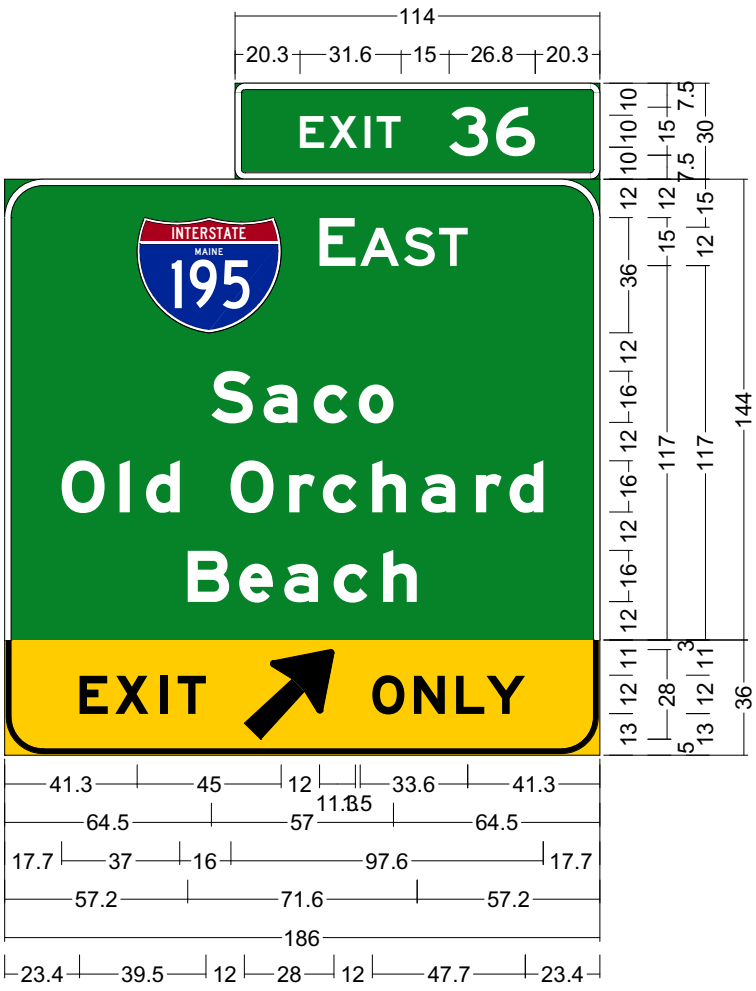
E 18.2	X 27.4	I 38.5	T 42.3	S 51.2	3 74.3	6 88.9	▬ 108.6	3 123.6	5 137.8
195 32.5	E 89.5	A 102.2	S 115.7	T 126.8	112 153.8	T 216.8	O 227.5	1 249.5	
S 123.4	a 144.0	c 163.4	o 181.0						
O 18.3	I 39.5	d 48.2	O 81.4	r 102.7	c 114.9	h 132.8	a 150.6	r 169.8	d 182.1	B 215.3	e 234.4	a 250.8	c 268.7	h 286.5
½ 117.9	M 160.3	I 174.7	L 180.0	E 191.1					



E1-5P-36-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXITS", E 2K 120% spacing; "36", E 2K; "35", E 2K;

GS-13;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; State Highway 112 M1-5; "TO", E 2K; "Saco", E Mod 2K;
"Old Orchard Beach", E Mod 2K 75% spacing; Arrow Custom - 31.5" 45';
Table of letter and object lefts

E 18.2	X 27.4	I 38.5	T 42.3	S 51.2	3 74.3	6 88.9	▬ 108.6	3 123.6	5 137.8
195 32.5	E 89.5	A 102.2	S 115.7	T 126.8	112 153.8	T 216.8	O 227.5	1 249.5	
S 123.4	a 144.0	c 163.4	o 181.0						
O 18.3	l 39.5	d 48.2	O 81.4	r 102.7	c 114.9	h 132.8	a 150.6	r 169.8	d 182.1	B 215.3	e 234.4	a 250.8	c 268.7	h 286.5
↗ 146.7									

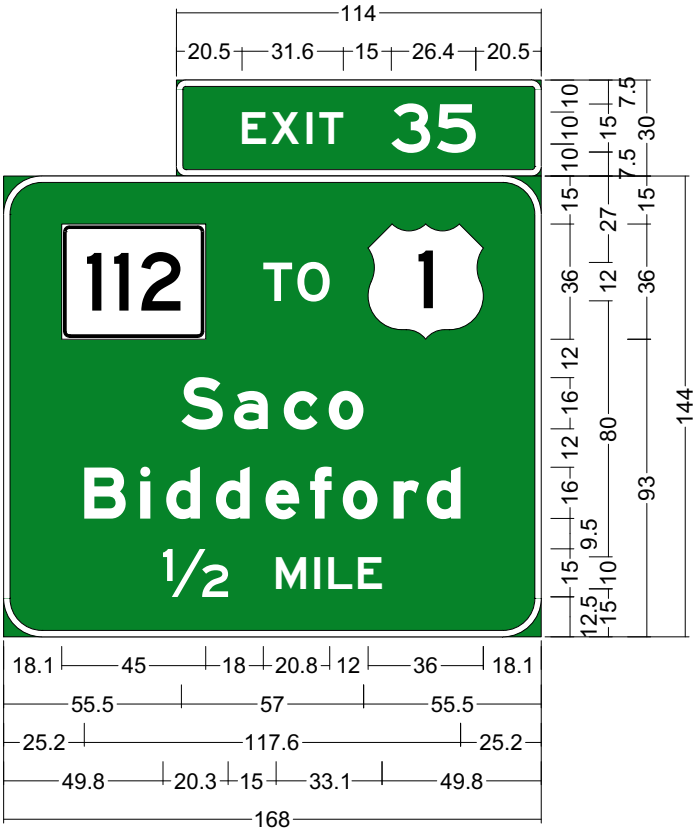


E1-5P-36;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "36", E 2K;

GS-15;
12.0" Radius, 2.0" Border, White on, Green;
M1-1_195_ME; "EAST", E 2K; "Saco", E Mod 2K;
"Old Orchard", E Mod 2K; "Beach", E Mod 2K;

12.0" Radius, 1.5" Border, 0.5" Indent, Black on, Yellow;
"EXIT", E Mod 2K 140% spacing;
Arrow Custom - 35.6" 45'; "ONLY", E Mod 2K;
Table of letter and object lefts

E 20.3	**X** 29.4	**I** 40.5	**T** 44.4	**3** 66.9	**6** 81.6
41.3	**E** 98.3	**A** 111.1	**S** 124.6	**T** 135.7	
S 64.5	**a** 81.0	**c** 96.5	**o** 110.6		
O 17.7	**l** 36.0	**d** 44.1			
	O 70.7	**r** 88.9	**c** 99.3	**h** 114.8	**a** 130.4	**r** 147.3	**d** 157.7
B 57.2	**e** 73.2	**a** 87.2	**c** 102.8	**h** 118.3			
E 23.4	**X** 34.6	**I** 48.6	**T** 54.0	↗ 74.9	**O** 114.9	**N** 127.8	**L** 140.9	**Y** 150.5



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-16;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Biddeford", E Mod 2K;
"½ MILE", E 2K;
Table of letter and object lefts

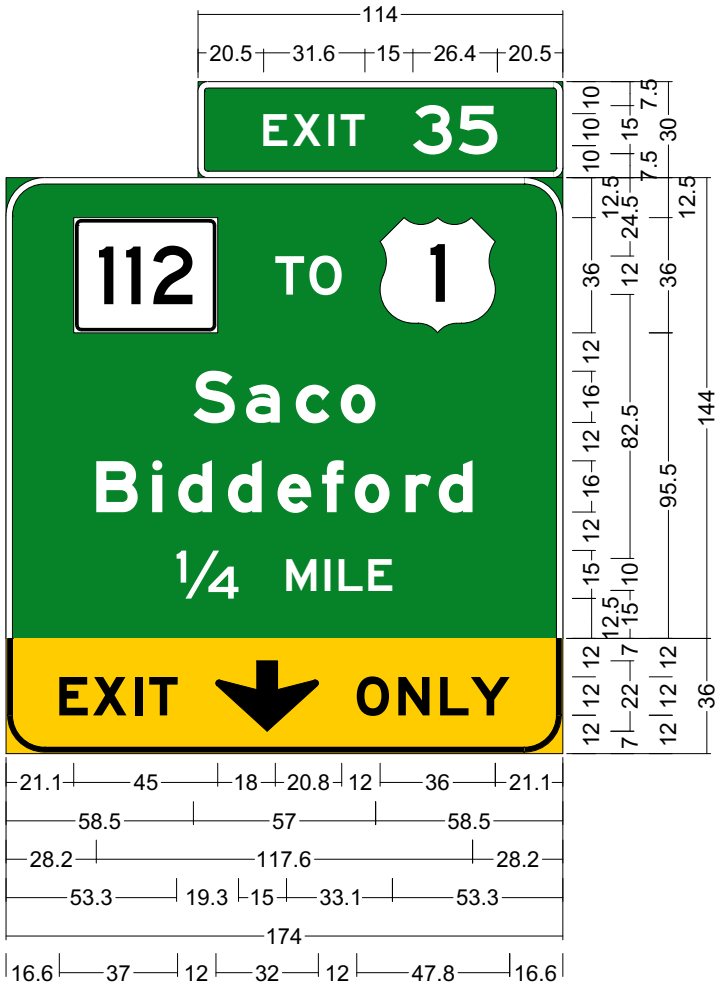
E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4

112 18.1	**T** 81.1	**O** 91.8	1 113.9

S 55.5	**a** 72.0	**c** 87.5	**o** 101.6

B 25.2	**i** 42.6	**d** 50.8	**d** 66.3	**e** 81.8	**f** 95.8	**o** 106.0	**r** 121.8	**d** 132.2

½ 49.8	**M** 85.1	**I** 97.1	**L** 101.5	**E** 110.7



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-17;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Biddeford", E Mod 2K;
"¼ MILE", E 2K;

12.0" Radius, 1.5" Border, 0.5" Indent, Black on, Yellow;
"EXIT", E Mod 2K; Down Arrow 22.0" 270';
"ONLY", E Mod 2K;
Table of letter and object lefts

E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4

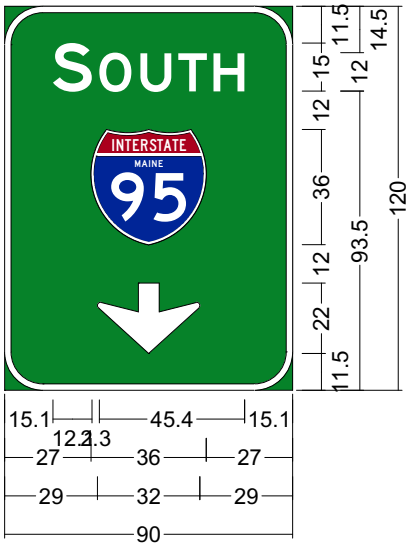
112 21.1	**T** 84.1	**O** 94.8	1 116.9

S 58.5	**a** 75.0	**c** 90.5	**o** 104.6

B 28.2	**i** 45.6	**d** 53.8	**d** 69.3	**e** 84.8	**f** 98.8	**o** 109.0	**r** 124.8	**d** 135.2

¼ 53.3	**M** 87.6	**I** 99.6	**L** 104.0	**E** 113.2

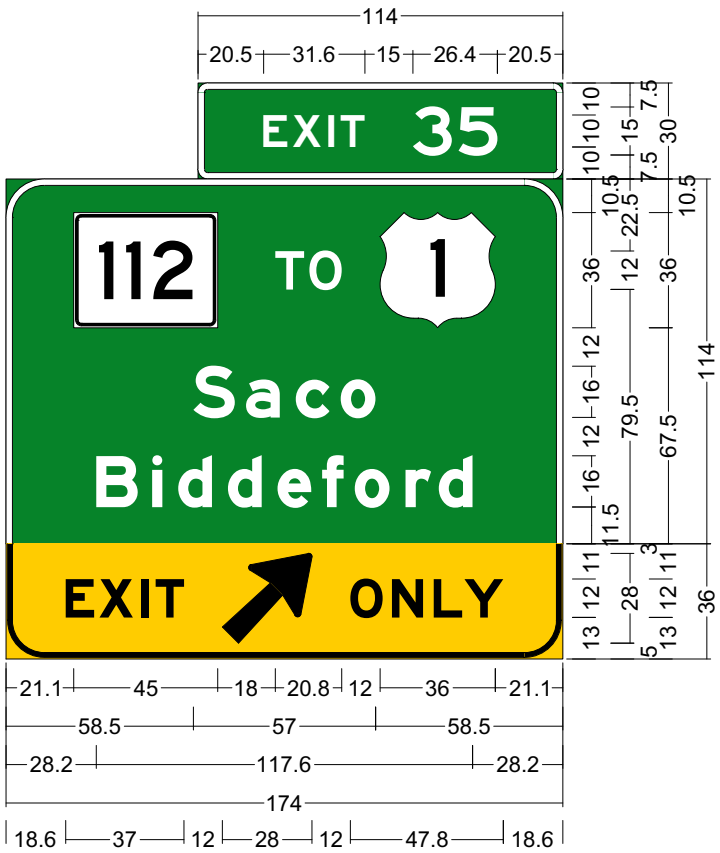
E 16.6	**X** 27.2	**I** 40.2	**T** 44.7	↓ 65.6	**O** 109.6	**N** 122.6	**L** 135.6	**Y** 145.2



GS-18;
Quantity : 2;
12.0" Radius, 2.0" Border, White on, Green;
"SOUTH", E 2K;
M1-1_95_ME;
Down Arrow 22.0" 270';
Table of letter and object lefts

S	O	U	T	H
15.1	29.5	42.4	54.1	65.2

95	27.0
	29.0



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-19;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Biddeford", E Mod 2K;

12.0" Radius, 1.5" Border, 0.5" Indent, Black on, Yellow;
"EXIT", E Mod 2K; Arrow Custom - 35.6" 45';
"ONLY", E Mod 2K;
Table of letter and object lefts

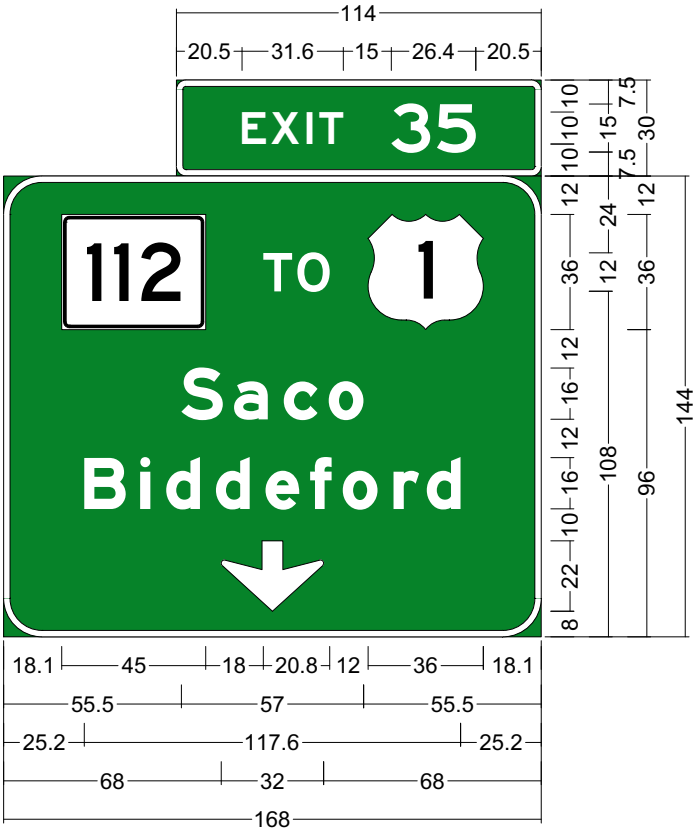
E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4

112 21.1	**T** 84.1	**O** 94.8	1 116.9

S 58.5	**a** 75.0	**c** 90.5	**o** 104.6

B 28.2	**i** 45.6	**d** 53.8	**d** 69.3	**e** 84.8	**f** 98.8	**o** 109.0	**r** 124.8	**d** 135.2

E 18.6	**X** 29.2	**I** 42.2	**T** 46.7	↗ 67.6	**O** 107.6	**N** 120.6	**L** 133.6	**Y** 143.2



E1-5P-35;
3.0" Radius, 2.0" Border, White on, Green;
"EXIT", E 2K 120% spacing; "35", E 2K;

GS-20;
12.0" Radius, 2.0" Border, White on, Green;
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Biddeford", E Mod 2K;
Down Arrow 22.0" 270';
Table of letter and object lefts

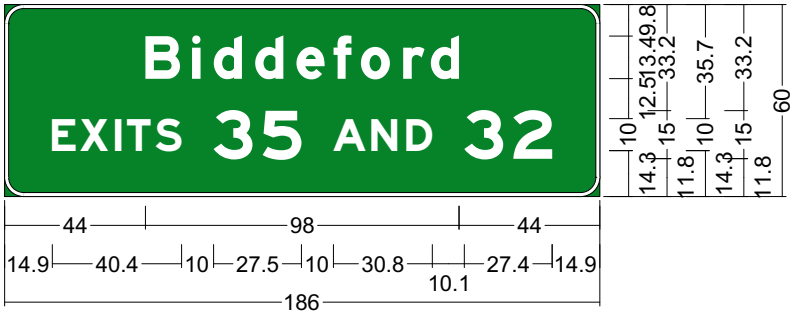
E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4

112 18.1	**T** 81.1	**O** 91.8	1 113.9

S 55.5	**a** 72.0	**c** 87.5	**o** 101.6

B 25.2	**i** 42.6	**d** 50.8	**d** 66.3	**e** 81.8	**f** 95.8	**o** 106.0	**r** 121.8	**d** 132.2

68.0

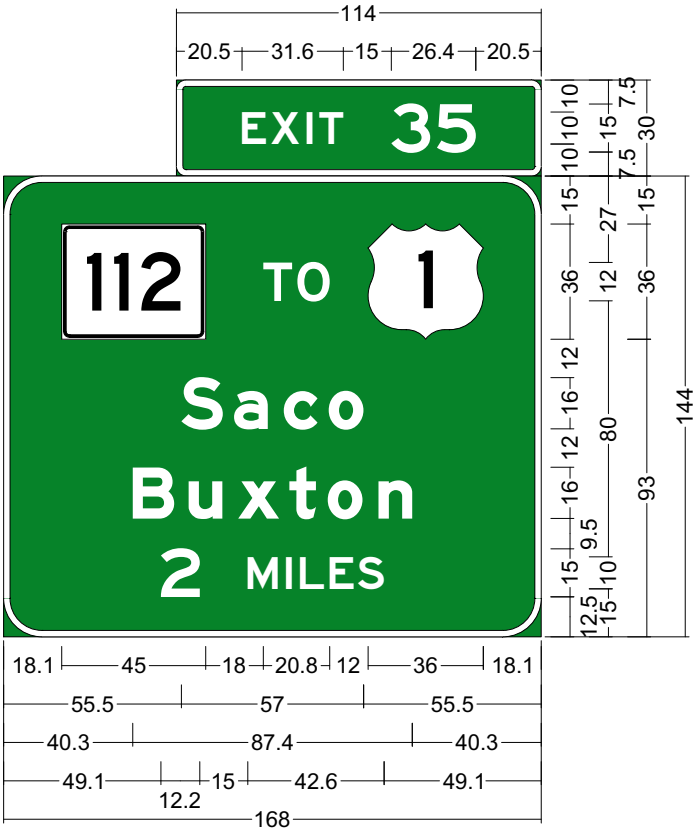


GS-21;
6.0" Radius, 1.3" Border, White on, Green;
"Biddeford", E Mod 2K;
"EXITS 35 AND 32", E Mod 2K;
Table of letter and object lefts

B 44.0	**i** 58.5	**d** 65.3	**d** 78.3	**e** 91.2	**f** 102.8	**o** 111.3	**r** 124.5	**d** 133.2

E 14.9	**X** 23.7	**I** 34.5	**T** 38.3	**S** 47.2	**3** 65.3	**5** 80.6	**A** 102.8	**N** 114.7	**D** 125.5

3 143.7	**2** 159.0



E1-5P-35;
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GS-25;
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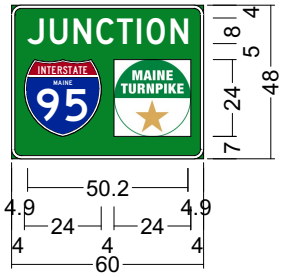
State Highway 112 M1-5; "TO", E 2K;
"Saco", E Mod 2K; "Buxton", E Mod 2K;
"2 MILES", E 2K;
Table of letter and object lefts

E 20.5	**X** 29.7	**I** 40.8	**T** 44.6	**3** 67.1	**5** 81.4
112 18.1	**T** 81.1	**O** 91.8	1 113.9		
S 55.5	**a** 72.0	**c** 87.5	**o** 101.6		
B 40.3	**u** 57.8	**x** 73.3	**t** 89.3	**o** 101.3	**n** 117.1
2 49.1	**M** 76.3	**I** 88.3	**L** 92.7	**E** 101.9	**S** 110.8



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"JUNCTION", D 2K;
M1-1_95_ME;
Table of letter and object lefts

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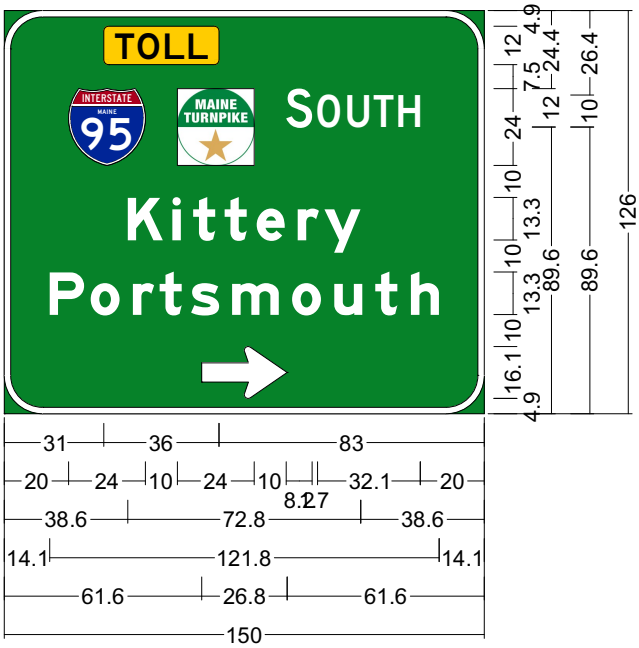
4.9	12.0	19.3	26.5	33.0	39.2	42.2	49.6

4.0	32.0



GS-27;
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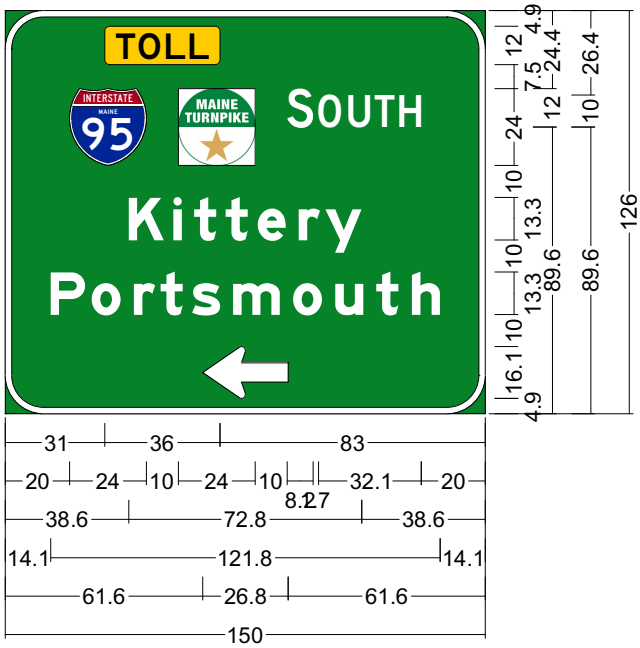
TOLL; M1-1_95_ME; "SOUTH", D 2K;
"Kittery", E Mod 2K;
"Portsmouth", E Mod 2K;
Standard Arrow Custom 26.8" X 16.1" 0';
Table of letter and object lefts

TOLL 31.0						
95 20.0	MAINE TURNPIKE 54.0	S 88.0	O 97.9	U 107.2	T 115.5	H 123.2
K 38.6	i 52.5	t 59.0	t 68.7	e 78.7	r 91.7	y 100.1
P 14.1	o 26.9	r 40.1	t 48.5	s 58.3	m 71.2	o 90.0
u 103.2	t 115.9	h 127.1				
→ 61.6						



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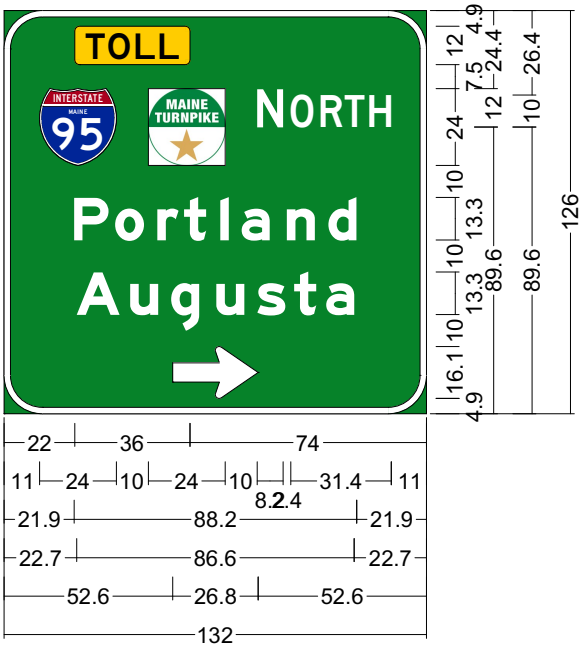
TOLL; M1-1_95_ME; "SOUTH", D 2K;
"Kittery", E Mod 2K;
"Portsmouth", E Mod 2K;
Standard Arrow Custom 26.8" X 16.1" 180';
Table of letter and object lefts

TOLL 31.0						
95 20.0	MAINE TURNPIKE 54.0	S 88.0	O 97.9	U 107.2	T 115.5	H 123.2
K 38.6	i 52.5	t 59.0	t 68.7	e 78.7	r 91.7	y 100.1
P 14.1	o 26.9	r 40.1	t 48.5	s 58.3	m 71.2	o 90.0
u 103.2	t 115.9	h 127.1				
← 61.6						



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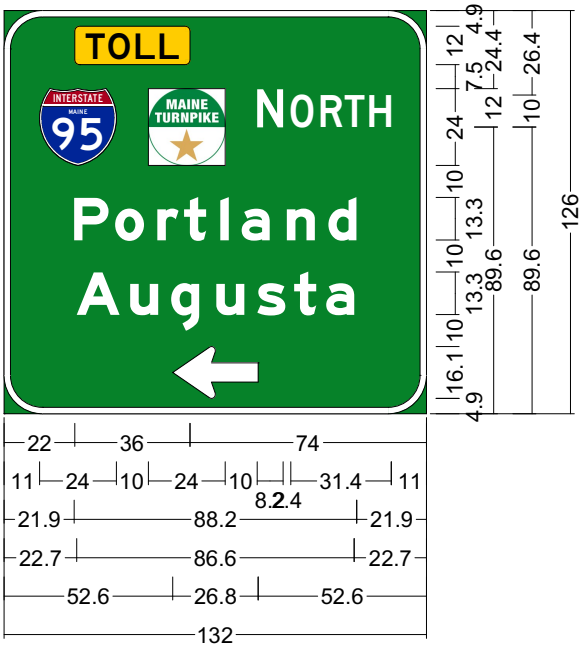
"Portland", E Mod 2K;
"Augusta", E Mod 2K;
Standard Arrow Custom 26.8" X 16.1" 0';
Table of letter and object lefts

TOLL 22.0							
95 11.0	45.0	N 79.0	O 89.6	R 98.9	T 106.5	H 114.2	
P 21.9	o 34.7	r 47.9	t 56.3	l 67.5	a 74.3	n 88.4	d 101.3
A 22.7	u 39.3	g 52.3	u 66.4	s 79.1	t 90.5	a 100.5	
52.6							



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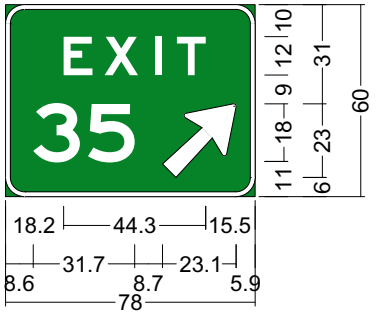
"Portland", E Mod 2K;
"Augusta", E Mod 2K;
Standard Arrow Custom 26.8" X 16.1" 180';
Table of letter and object lefts

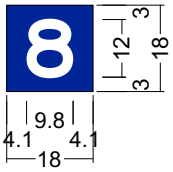
TOLL 22.0						
11.0	45.0	N 79.0	O 89.6	R 98.9	T 106.5	H 114.2
P 21.9	o 34.7	r 47.9	t 56.3	l 67.5	a 74.3	n 88.4	d 101.3
A 22.7	u 39.3	g 52.3	u 66.4	s 79.1	t 90.5	a 100.5
52.6						



E5-1A-35;
Quantity : 2;
6.0" Radius, 1.5" Border, White on, Green;
"EXIT", E 2K 225% spacing;
"35", E 2K;
Arrow Custom - 29.3" 45';
Table of letter and object lefts

E 18.2	**X** 30.9	**I** 46.8	**T** 53.5

3 8.6	**5** 25.7	↗ 49.0

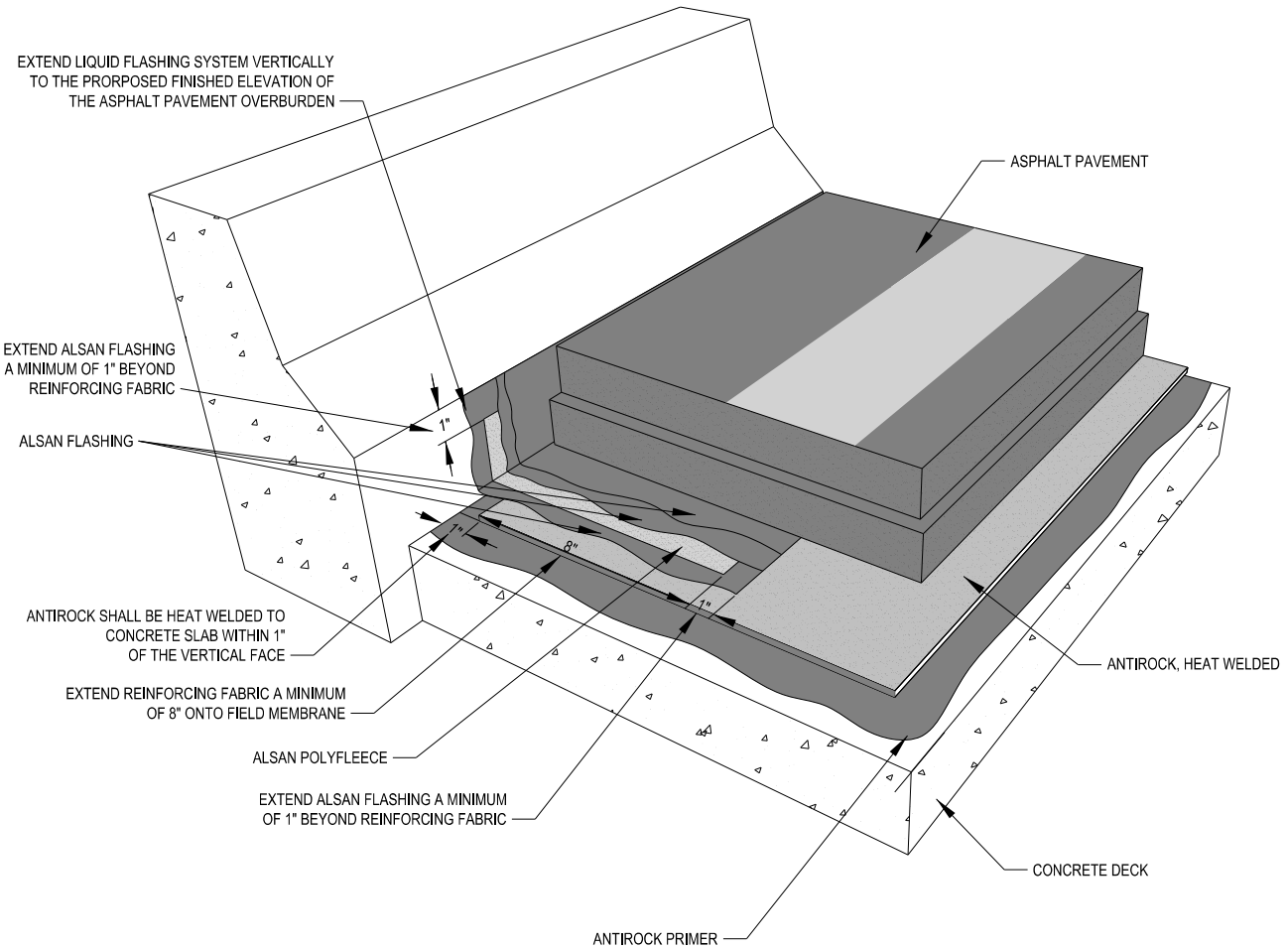


Sign # : 4;
Sign Type : overlay;
No border, None on, Blue;
"8" White, E 2K;
Table of letter and object lefts

8	
4.1	

APPENDIX D

Product Data Sheets



NOTES:

1. SOPREMA DETAIL DRAWINGS: REFER TO SOPREMA AND OTHER RELATED PUBLISHED DOCUMENTATION, PRODUCT DATA SHEETS (PDS) AND SAFETY DATA SHEETS (SDS) FOR ADDITIONAL INFORMATION. ALL DETAIL DRAWINGS AND RELATED INSTALLATION GUIDELINES ARE PROVIDED BY SOPREMA FOR THE SOLE PURPOSE OF ISSUING A SOPREMA WARRANTY. ACCORDINGLY, THE DETAIL DRAWINGS ARE NOT OFFERED, AND SHOULD NOT BE CONSIDERED, AS A SUBSTITUTE FOR PROFESSIONAL DESIGN SERVICES.
2. HOT WORK: THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING APPROPRIATE CONDITIONS TO UTILIZE HEAT-WELDING EQUIPMENT. REFER TO LOCAL CODES OWNER'S REQUIREMENTS FOR HOT WORK OPERATIONS.
3. PRIMER: WHERE NOT SHOWN OR INDICATED ON DETAIL DRAWINGS, REFER TO MATERIAL PRODUCT DATA SHEETS FOR PRIMER APPLICATION REQUIREMENTS.

SOPREMA®
US CORPORATE ADDRESS
310 QUADRAL DRIVE
WADSWORTH, OHIO 44281
www.soprema.us
Tel:330.334.0066

PROJECT:

TITLE: ANTIROCK SBS MEMBRANE, CIVIL ENGINEERING, UPSTAND

DRAWN BY: SOPREMA TECHNICAL SUPPORT, GGALLOWAY

NO.:	REVISION:	DATE:

DATE: 10.4.2018

SCALE: NTS

DRAWING NUMBER: **US.CE.02.01**

Direct-View LED Traffic Controller
DOT2424RG-175

PRODUCT NUMBER
5651

CABINET DIMENSIONS
24" H x 24" W x 5" D

ILLUMINATION SOURCE
Super bright, narrow viewing angle LEDs
Available in green, red, blue, amber, and white LEDs
Messages "blankout" when turned off, eliminating confusion
Long life, solid state lighting

ELECTRICAL
Integrated solid state power supply
Photocell for auto photodimming
Standard Voltage: 120 VAC, Optional Voltages: 9-36 V, 240 VAC, 277 VAC
Maximum amps per lighted message (at 120 V) shown in the table below
UL/CUL approved for wet locations

CONSTRUCTION
Faces: Single Faced Sign
Cabinet: (DOT): NEMA 4X Rated, 1/8" wall T5052 aluminum cabinet with continuously welded seams. Optional Visor
Door: Continuous hinge with a 1" x 1/4" silicone gasket and stainless steel tool free door latches
Face Material: Impact resistant, 1/4" thick smoke tinted polycarbonate

FINISH
Standard Cabinet Color: Black
Custom colors available upon request

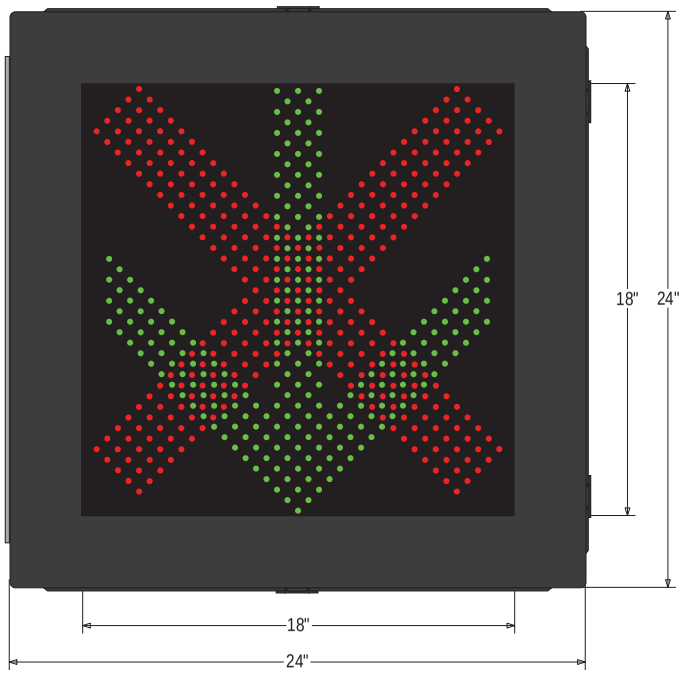
MESSAGE	COLOR	HEIGHT	AMPS
X	30° Red Round	18.0"	0.17
Down Arrow	30° Green Round	18.0"	0.13

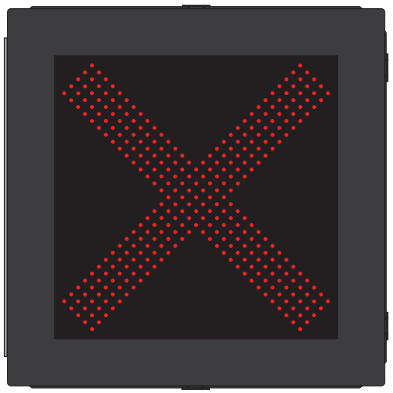
Trans-Tech
4999 Pittsburgh Ave.
Erie, PA 16509
Phone: (888) 811-7010
Fax: (814) 836-8401
Email: sales@transportation-tech.com
Website: www.transportation-tech.com

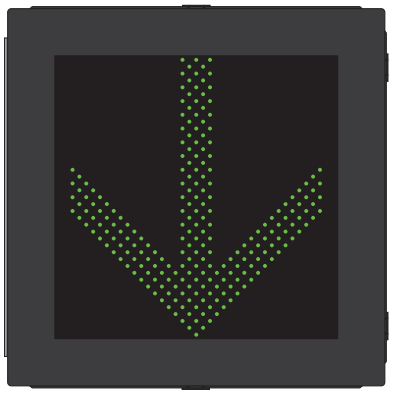
Proudly Made in the USA

Product View

NOTE: Sign image may not exactly represent the finished product. For illustration purposes only.

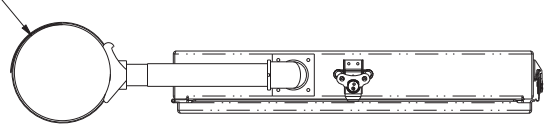


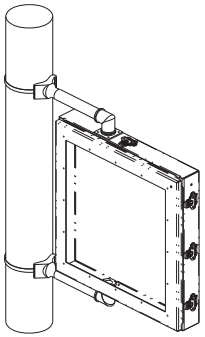


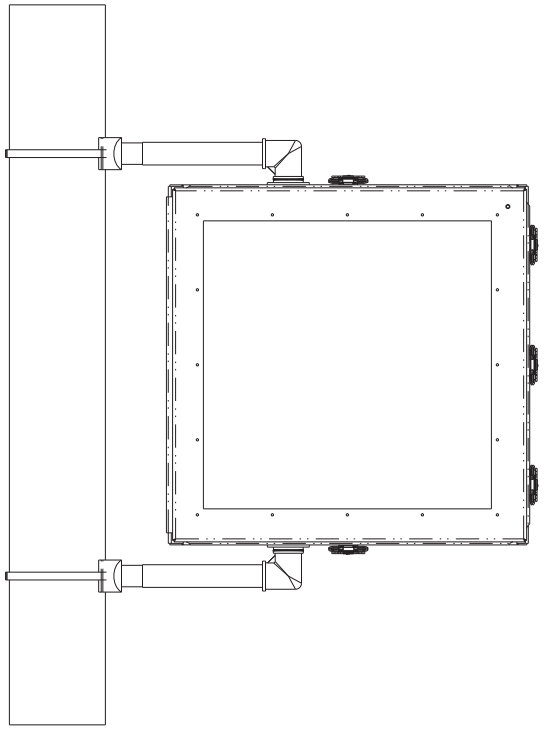


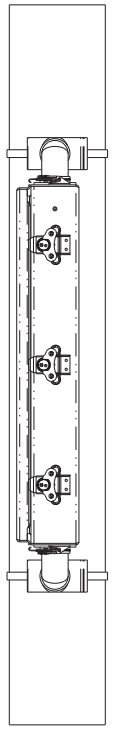
R-325
G-229

∅8" POST,
FOR ILLUSTRATION

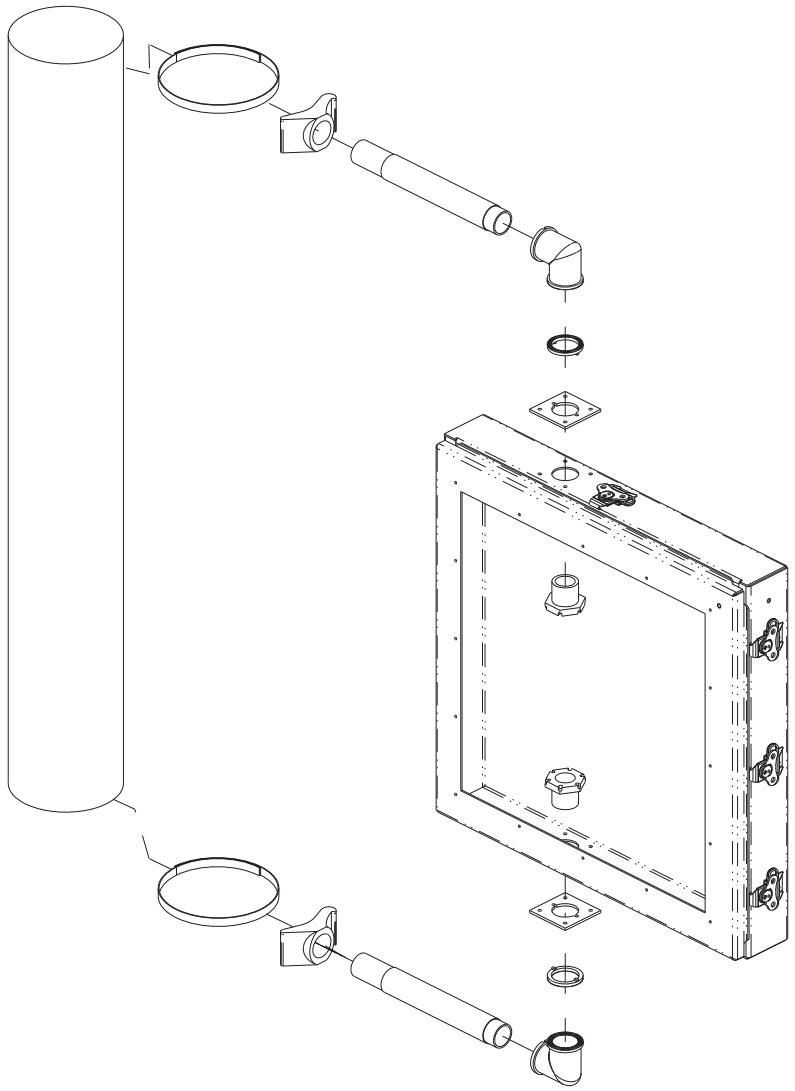








TYP TOL: ±1/16" ANGLES: ±2°		DATE: 10-MAR-11 SHEET 1 OF 3	3030 DOT, PELCO-MOUNTING	INV ID#:
		Signal-Tech	JDG	PROD ID#:
			4985 Pittsburgh Ave Erie, PA 16509	CUST ID#:



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		SignalTech	JDG	PROD ID#:
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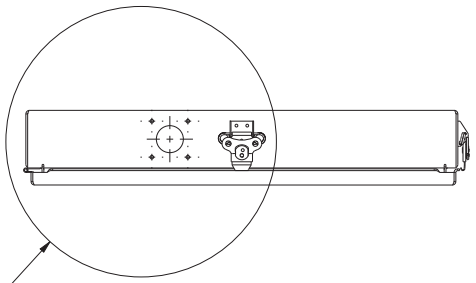
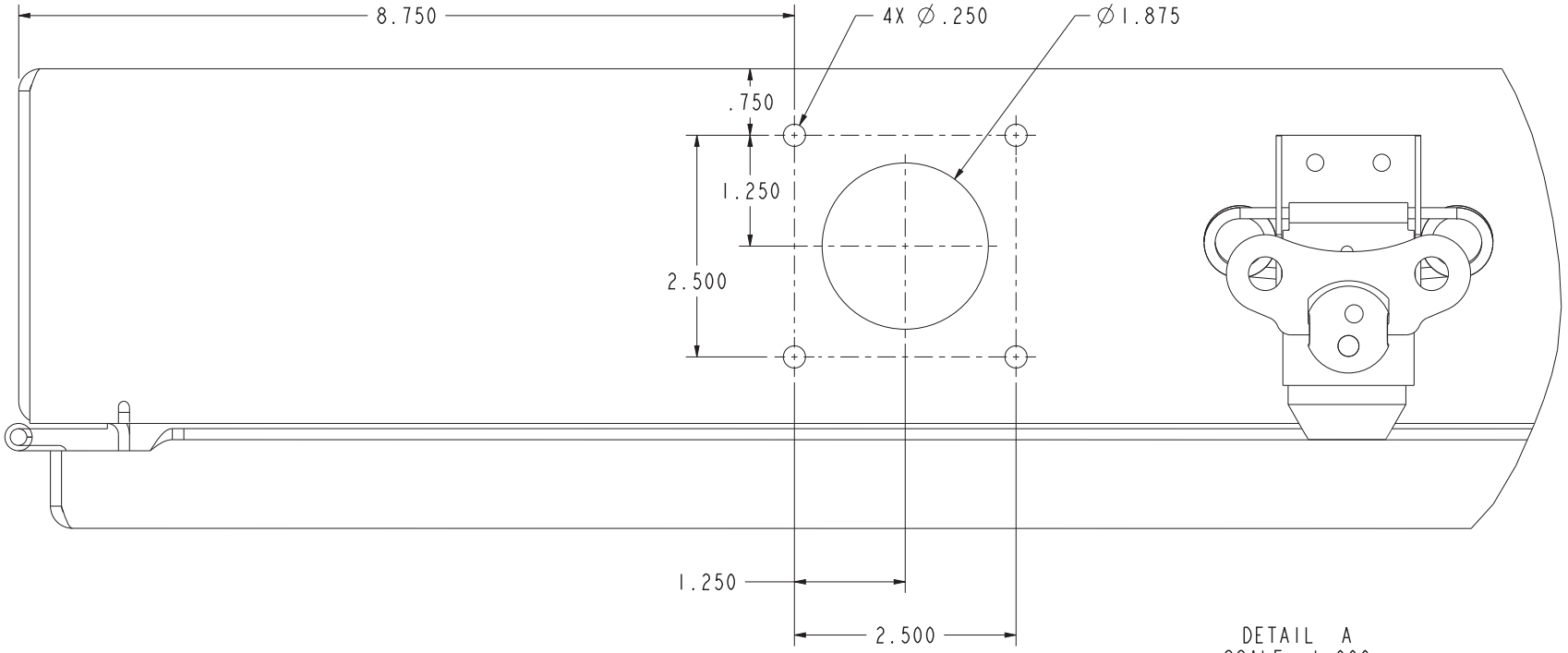




DETAIL A
SCALE 1.000

TYP TOL: ±1/16" ANGLES: ± 2°		DATE: 10-MAR-11 SHEET 3 OF 3	3030 DOT, PELCO-MOUNTING	INV ID#:
		Signal-Tech	JDG	PROD ID#:
			4985 Pittsburgh Ave Erie, PA 16509	CUST ID#:

APPENDIX E

Defined Terms

DEFINED TERMS

- AVI (Automatic Vehicle Identification): a system consisting of an antenna and reader installed in a toll lane for communication with a transponder located on a vehicle for automatic identification of the transponder as it passes through the lane.

- Canopy Override Switch (COS): shall mean the switch that controls the signal that is located on the canopy on the entry side of each toll lane.

- Sensor Loops: a system for automatic vehicle detection, separation and classification.

- COMM - Communications

- Components: parts that compose a device or piece of equipment.

- DVAS (Digital Video Audit System) – A video camera and image storage system that captures traffic movements in the lane 24 hours a day.

- EMT - Electrical Metallic Tubing

- Gradient Sensor – Part of the Sensor Loop system - a gradient sensor is placed on each side of the Primary sensor.

- Contractor: the Contractor hired by the Authority through a solicitation process to complete the Project.
-
- JB - Junction Box

- Lane Controller (LC): A computer system for each type of toll lane that controls the lane equipment.

- Manual Lane Terminal (or MLT): A device consisting of an array of touch screen buttons and associated electronics for processing toll transactions in the attended tollbooths.

- MTA - Maine Turnpike Authority

- NTS -Not to Scale

- Paypoint Sensor – Part of the Sensor Loop system. Detects when the vehicle has reached the lane paypoint, in this case the tollbooth door centerline.

- Primary Sensor – Part of the Sensor Loop system. Located between two gradient sensors, a 6’ x ‘6 square sensor that participates in vehicle classification.

- Project: shall mean the upgrade of the existing New Gloucester Barrier Toll Lane 8 to the toll collection system described in herein.

- RMC - Rigid Metallic Conduit

- RP (Receipt Printer) – Receipt printer that communicates with the payment system. Located in the booth.

- Specifications: shall mean the Technical Specification and instructions included in this document for the purpose of defining the installation procedures

- SI (Systems Integrator) - The systems integrator/contractor for the MTA toll system.

- SS - Stainless Steel

- TCP (Traffic Control Pedestal): A pedestal to mount a traffic signal and screen with a message to patrons.

- UPS - Uninterrupted Power Supply

- VES (Violation Enforcement System) – Cameras that automatically capture digital photographic images of vehicles and their license plates.

APPENDIX F

Plaza Work Checklist

PLAZA – WORK CHECKLIST

DATE SUBMITTED:		**DATE APPROVED:**				
REVISION #1:		**DATE APPROVED:**				
REVISION #2:		**DATE APPROVED:**				

PROPOSED EQUIPMENT	**PROPOSED LOCATION**	**POWER SOURCE**		**EXTRA WORK (Y/N)**	**APPRVL DATE**	**APPRVL BY**
		PANEL	**CIRCUIT**			
AVI READERS						
SENSOR LOOPS						
DVAS CAMERA MOUNTS						
ORT LANE CONTROLLER CABINETS						
VCARS CAMERAS						
OPUS SCANNERS						
AVI ANTENNAS						
LIGHTNING SUPPRESSION SYSTEMS						
SPACE FRAME LIGHTING SYSTEMS						

EXISTING TO REMAIN EQUIPMENT	**LOCATION**	**POWER SOURCE**		**EXTRA WORK (Y/N)**	**APPRVL DATE**	**APPRVL BY**
		PANEL	**CIRCUIT**			
UPS IN BUILDING						

EXISTING EQUIPMENT TO BE REMOVED	**LOCATION**	**POWER SOURCE**		**EXTRA WORK (Y/N)**	**APPRVL DATE**	**APPRVL BY**
		PANEL	**CIRCUIT**			
ENTRY LOOPS						
EXIT LOOPS						
TREADLES						
LIGHT CURTAIN						
PATRON FARE DISPLAY						
ISLAND TRAFFIC LIGHT						
OVERHEAD SCANNER						
CANOPY OVERRIDE SWITCH						
LANE USE SIGNAL						
RED LIGHTS						
AVI ANTENNAS						
PORTION OF LIGHTNING SUPPRESSION SYSTEM						
PORTION OF CANOPY LIGHTING						

EXPLANATION OF ALL EXTRA WORK (USE ADDITIONAL SHEET IF REQUIRED)

APPENDIX G

Maine Department of Environmental Protection (DEP) Natural Resources Protection Act Individual Permit

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
17 STATE HOUSE STATION AUGUSTA, MAINE 04333-0017

DEPARTMENT ORDER

IN THE MATTER OF

MAINE TURNPIKE AUTHORITY	) NATURAL RESOURCES PROTECTION ACT
Saco, York County	) FRESHWATER WETLAND ALTERATION
NEW EXIT 35 AND	) WETLANDS OF SPECIAL SIGNIFICANCE
EXIT 36 IMPROVEMENTS	) STREAM ALTERATION
L-29582-TG-A-N (approval)	) WATER QUALITY CERTIFICATION
L-29582-2G-B-N (approval)	) FINDINGS OF FACT AND ORDER
(*CORRECTED ORDER)	

Pursuant to the provisions of 38 M.R.S. §§ 480-A–480-JJ, Section 401 of the Federal Water Pollution Control Act (33 U.S.C. § 1341), and Chapters 310 and 315 of Department rules, the Department of Environmental Protection (Department) has considered the application of the MAINE TURNPIKE AUTHORITY (the applicant) with the supportive data, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

1. PROJECT DESCRIPTION:

A. Summary: The applicant proposes to make improvements to Interstate 95 (Turnpike) Exit 36 and construction of a new Exit 35 that includes the following: new on and off ramps for southbound access; re-establishing the existing Exit 5 on and off ramps northbound to Route 112; establishing collector-distributor roadway for the southbound mainline; reconfiguration to Exit 36 northbound off ramp; realignment of Exit 36 southbound on and off ramps; construction of a new intersection with lights on Route 112; construction of a toll plaza, administrative building and parking for each Exit 35 northbound and southbound on ramp; and a new larger Park and Ride lot west of Exit 35.

The applicant proposes temporary and permanent impacts to 24 wetlands in the Saco River and Goosefare Brook watersheds that will result in 132,040 square feet (3.02 acres) of permanent wetland fill or grading and 8,754 (0.20 acres) of temporary wetland alterations. Direct wetland impacts include approximately 2.10 acres of freshwater meadow/emergent marsh meadow wetland, some of which are maintained (mowed less than two times a year) by the applicant, and approximately 0.91 acres of freshwater scrub shrub and forested wetlands. Temporary impact areas will be restored to pre-construction surface grades and vegetation cover when the project is complete. The applicant stated that the project will not result in any conversion of forested to non-forested wetland, but will require approximately 5.75 acres of tree removal in uplands and wetland areas associated with the project area. The applicant is also proposing to alter 279 linear feet (*1,432 square feet) of stream due to the 24-foot culvert extension and realignment of a portion of Goosefare Brook discussed further in Finding 4.

The proposed project is shown on a set of plans, the first of which is titled "Interchange Improvements Saco (Exits 35 & 36)", prepared by Stantec Consulting Services, Inc. and dated October 21, 2021, with the latest revision date of June 22, 2022.

The applicant submitted a Permit by Rule Notification Form (PBR #74204) for state transportation facilities and activities within significant vernal pool habitat pursuant to Chapter 305 Permit by Rule Standards Section 11 and Section 19 (06-096 Ch. 305, § 11 and 19 last amended June 8, 2012) that include areas within and outside the proposed project area. Activities will include pavement rehabilitation, installation of safety improvements, maintenance of existing culverts at Exit 36 from Turnpike Mile Marker (MM) 35.5 and 36.2 in Saco. Additonally, the work will include outlet ditching at an existing culvert at MM 34.9 and removal of 20 linear feet of culvert within Goosefare Brook east of the Exit 36 northbound off ramp. The PBR #74204 was accepted by the Department on February 2, 2022. Approximately 609 square feet of wetland impacts associated with the construction of a new acceleration lane at the existing Exit 36 northbound on ramp will be compensated for as discussed further in Finding 6.

Current Use of the Site: The proposed project extends along both sides of the Turnpike from the northern side of Route 5 (New County Road) overpass to approximately one mile northwest of the Exit 36 I-195 interchange, and in areas along State Route 112 and the I-195 interchange.

C. Title Right and Interest: The applicant has acquired ownership of property to construct the new Exit 35 southbound off ramp. Additional fee acquisition is underway for two additional properties for other portions of the project. The applicant is in the process of acquiring drainage easements, access easements, highway easements, and temporary construction rights from additional properties and anticipates these to be secured by the end of September 2022. Acquisition of land rights for the project are being sought through negotiation with property owners and, if required, by eminent domain pursuant to 23 M.R.S. § 1965 (1)(G).

2. EXISTING SCENIC, AESTHETIC, RECREATIONAL OR NAVIGATIONAL USES:

The Natural Resources Protection Act (NRPA), in 38 M.R.S. § 480-D(1), requires the applicant to demonstrate that the proposed project will not unreasonably interfere with existing scenic, aesthetic, recreational and navigational uses.

In accordance with Chapter 315, *Assessing and Mitigating Impacts to Scenic and Aesthetic Uses* (06-096 C.M.R. ch. 315, effective June 29, 2003), the applicant submitted a copy of the Department's Visual Evaluation Field Survey Checklist as Appendix A to the application along with a description of the property and the proposed project. The applicant also submitted several photographs, including an aerial photograph, of the proposed project site.

The proposed project consists of improvements to the Turnpike and within or adjacent to the Turnpike travel corridor, right-of-way and existing interchange of northbound and

southbound roadways at Exit 35 and Exit 36. The wetlands and streams in this area are not considered scenic resources visited by the general public, in part, for the use, observation, enjoyment and appreciation of its natural and cultural visual qualities.

The Department finds that the proposed activity will not unreasonably interfere with existing scenic, aesthetic, recreational or navigational uses of the freshwater wetlands or the unnamed stream that will be altered.

3. SOIL EROSION:

The NRPA, in 38 M.R.S. § 480-D(2), requires the applicant to demonstrate that the proposed project will not cause unreasonable erosion of soil or sediment nor unreasonably inhibit the natural transfer of soil from the terrestrial to the marine or freshwater environment.

In order to minimize sedimentation into protected natural resources, construction will be performed using a number of erosion and sedimentation control measures based on the latest version of the *Maine Department of Transportation Best Management Practices for Erosion and Sediment Control* (BMPs) and the applicant's standards and specifications (Supplemental Specification Section 656, Temporary Soil Erosion and Water Pollution Control). The applicant stated that for each construction project, it implements a Construction Project Environmental Compliance Program, which assigns a Resident Engineer and Compliance Officer, whose roles include inspection of all construction projects and weekly inspection of erosion and sedimentation control devices, respectively. In addition, Supplemental Specification Section 656 requires each contractor to certify that its on-site responsible party has been trained and is knowledgeable in erosion and sediment control. Supplemental Specification Section 656 also establishes an overview of preparatory activities, excavation activities, construction activities (including spill prevention and control), a post-construction work plan, and a schedule of construction activity. Periodic inspections of the overall project, including the effectiveness and condition of erosion and sediment control devices are conducted by the applicant's Permitting Coordinator/Environmental Liaison.

Based on the applicant's use of BMP's and its own erosion control specifications, the Department finds that the activity will not cause unreasonable erosion of soil or sediment nor unreasonably inhibit the natural transfer of soil from the terrestrial to the marine or freshwater environment.

4. HABITAT CONSIDERATIONS:

The NRPA, in 38 M.R.S. § 480-D(3), requires the applicant to demonstrate that the proposed project will not unreasonably harm significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine or marine fisheries or other aquatic life.

The project area is located along and adjacent to existing roadway infrastructure. The topography is flat to gently sloping and includes small rolling hills in the southern portion of the site. The upland area is a mix of meadow, shrub and forest.

The applicant provided a letter from the Department of Inland Fisheries and Wildlife (MDIFW) dated April 16, 2020 that stated there are no mapped Significant or Essential Wildlife Habitat located in the project area. MDIFW also stated that although Maine Endangered Species Act lists several endangered or threatened species of bats, and that bats are likely to be found on the project site during the breeding season, no significant impacts are anticipated to any of the bat species as a result of the project.

The applicant provided results from a vernal pool survey that was conducted on April 3, 2020 and April 21, 2020 that confirmed none of the potential vernal pools identified within the project area, further described in in the Wetland Delineation Report, discussed in Section 6, are significant wildlife habitats pursuant to the NRPA.

The applicant is proposing a 24-foot culvert extension and associated realignment of 279 linear feet (*1,432 square feet) of a segment of Goosefare Brook, a designated urban impaired stream. In addition to the stream impacts to Goosefare Brook (designated as S08 on the plans referenced in Finding 1), 2,327 square feet of permanent impacts to scrub shrub wetlands are proposed in the existing stream floodplain.

In comments, dated March 15, 2022, MDIFW stated that to minimize impacts to inland fisheries in Goosefare Brook, it recommended that fish and aquatic organism passage be maintained, and that the realigned stream reach also be stabilized and revegetated. MDIFW further stated that for projects involving stream realignments like the proposed project, all efforts should be made by the applicant to move the new stream channel further away from road; therefore, MDIFW recommended avoiding moving Goosefare Brook closer to the highway as proposed. Additionally, MDIFW recommended larger shrubs and small trees be incorporated into the planting plan to provide additional stabilization and protection from stormwater runoff, and to accommodate impacts from the reduced floodplain width between the realigned stream channel and Exit 36 on-ramp. MDIFW recommend a more natural stream channel, with substrate similar to a natural channel, and not the heavily armored, riprap approach currently proposed, and that if riprap scour protection aprons are needed, MDIFW recommended that the aprons be set below streambed elevation (4-6 inches) and then riprap be used to fill to streambed elevation with streambed-like gravel filling the voids and helping to prevent a fish passage barrier during low flows. Lastly, MDIFW recommended construction BMP's be utilized, all in-stream work be conducted from July 15 to September 30 in any calendar year, and post-construction monitoring be required to ensure stream bank stability and success.

In a letter dated April 6, 2022, the applicant responded and stated that although the stream will be aligned closer to the Exit 36 southbound on-ramp, the proposed culvert extension and realignment will utilize best practices for stream channel design and will improve the currently degraded and altered segment of Goosefare Brook in the following

ways: by alleviating a significant bend in the culvert that now exists and improving hydraulics at the inlet; by allowing additional flow depths for aquatic organisms in the reach during normal and low flow periods; and by adding additional floodplain at the nearest location to the southbound on-ramp with plantings and buffer area to be monitored and maintained.

The applicant further stated that the proposed floodplain grading and proposed planting plan exceeds the existing wetland floodplain impact area (designated as W32 on the plans referenced in Finding 1) by approximately 1,000 square feet. However, in response to comments from MDIFW, the applicant made further adjustments to the proposed plan by including additional grading to tie into the existing grading, thereby providing more floodplain area for riparian stabilization and stream buffer runoff protection.

The applicant agreed to the addition of saplings and shrub plantings to be maintained at an 80% survival rate in the regraded riparian floodplain for two years following installation along Goosefare Brook. The applicant will monitor the shrub and sapling survival rates during the two-year establishment period and replace dead shrubs and saplings to meet the 80% survival requirement.

Given the planting and monitoring proposed, the Department finds the reconstructed stream channel will result in habitat and floodplain improvements in this stream segment of Goosefare Brook, and therefore no compensation is required for alteration of the stream. The applicant will be required to pay a compensation fee for riparian wetland impacts that is further discussed in Finding 6.

At the request of the applicant, MDIFW agreed, in an email dated May 16, 2022, to allow in-stream work to be performed from June 1 to September 30.

Based on the construction plan proposed by the applicant in the segment of Goosefare Brook associated with the culvert extension, the Department finds that the activity will not unreasonably harm significant fisheries habitat. The Department further finds that, based on the revised grading plans, revegetation plan within the riparian floodplain and MDIFW's comments, the activity will not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine or marine fisheries or other aquatic life, provided that in-stream work is limited to the period of June 1 to September 30 and vegetation is monitored and maintained for two years as described above.

5. WATER QUALITY CONSIDERATIONS:

As discussed in Finding 3, the applicant proposes to use erosion and sediment control measures during construction to minimize impacts to water quality from siltation.

The proposed project is located in the Goosefare Brook and Saco River watersheds. Goosefare Brook is classified as an urban-impaired stream that has been altered,

realigned and culverted through this section of the Turnpike. The proposed extension of the culvert and realignment of a segment of Goosefare Brook will improve flow at the inlet, alleviate a bend in this section of the stream that interrupts the natural flow of the stream, and will increase floodplain width and buffers allow for stormwater to be attenuated in the riparian wetlands between the stream and the Turnpike.

The applicant met with the Department on May 5, 2022 to discuss treatment of stormwater from the proposed project to avoid impacts to surface water quality. In accordance with the June 2017 Memorandum of Agreement (MOA) for Stormwater Management among the Maine Department of Transportation, the applicant, and the Department, the applicant modified its design to split underdrain soil filter (USF 1) into two smaller USFs (1A and 1B) and conducted other evaluations of flows to be consistent with the treatment standards set forth in the Department's Chapter 500, *Stormwater Management* (06-096 C.M.R. ch.500, last amended August 12, 2015).

Based on the location of the proposed project, the construction methods proposed, and the project design, the Department finds that the proposed project will maintain and protect existing uses and the level of water quality necessary to protect those existing uses, will protect the existing water quality of affected waters, will not significantly impair water quality of Goosefare Brook.

6. WETLANDS AND WATERBODIES PROTECTION RULES:

The applicant provided a Wetland and Watercourse Delineation, Vernal Pool Survey Report, and Wetland Function and Value Assessment (Report) conducted by Stantec Consulting Services Inc., dated January 15, 2021 for the proposed project. Field investigations were conducted between October 3, 2019, April 3, 2020 and April 21, 2020. The Report identified 45 wetlands and 11 watercourses within the project area. Wetland types in the project area were either forested, scrub-shrub or wet meadow wetlands.

The applicant is proposing temporary and permanent impacts to 24 wetlands in the Saco River and Goosefare Brook watersheds that will result in 132,040 square feet (3.03 acres) of permanent wetland fill or grading and 8,754 (0.20 acres) of temporary wetland alterations. Direct wetland impacts include approximately 2.10 acres of freshwater wet meadow, some of which are maintained (mowed less than two times a year) by the applicant, and approximately 0.91 acres of freshwater scrub shrub and forested wetlands. Temporary impact areas will be restored to pre-construction surface grades and vegetation cover. The applicant stated that the project will not result in any conversion of forested to non-forested wetland but will require approximately 5.75 acres of tree removal in uplands and wetland areas associated with the project area.

Based on the Report, 12 wetlands within the survey area meet the characteristics of Wetlands of Special Significance (WOSS); five wetlands are located within 25 feet of a stream and 100-year floodplain, four wetlands contain at least 20,000 square feet of emergent marsh vegetation, two wetlands are located within 25 feet of a stream and one

wetland is located within 100-year floodplain. Additionally, the 279 linear feet (*1,432 square feet) of stream impacts from the 24-foot culvert extension and associated realignment of a portion of Goosefare Brook (discussed in Finding 4) is also considered WOSS.

The *Wetlands and Waterbodies Protection Rules*, 06-096 C.M.R. ch. 310 (last amended November 11, 2018), interpret and elaborate on the NRPA criteria for obtaining a permit. The rules guide the Department in its determination of whether a project's impacts would be unreasonable. A proposed project would generally be found to be unreasonable if it would cause a loss in wetland area, functions and values and there is a practicable alternative to the project that would be less damaging to the environment. Each application for a NRPA permit that involves a freshwater wetland or stream alteration must provide an analysis of alternatives in order to demonstrate that a practicable alternative does not exist.

A. Avoidance. An applicant must submit an analysis of whether there is a practicable alternative to the project that would be less damaging to the environment and this analysis is considered by the Department in its assessment of the reasonableness of any impacts. Additionally, for activities proposed in, on, or over wetlands of special significance the activity must be among the types listed in Chapter 310, § 5(A) or a practicable alternative less damaging to the environment is considered to exist and the impact is unreasonable. The proposed project will encroach on existing streams and adjacent WOSS. A project such as this is among the activities specifically provided for in Chapter 310, § 5(A)(1)(a).

The application included an alternatives analysis for the proposed project completed by the applicant and dated November 16, 2021. The purpose of the proposed project is to provide a long-term solution to regional transportation needs associated with the westerly connections to the Turnpike in the vicinity of Exit 36 by improving access from Route 112 and separating through traffic that will ultimately improve safety for this section of the Turnpike. The proposed project is based on recommendations taken from the Maine Turnpike Needs Assessment-Safety and Capacity Study, dated May 2016 and the more recent Saco Route 112/Exit 36 Area Transportation Study, dated July 2019, which was a joint initiative between the City of Saco, the applicant, and Maine Department of Transportation. The applicant examined three alternatives, including the no-action alternative, in its initial (Phase 1) determination for the most practicable alternative that would meet the project purpose. Design considerations included indirect access to the west of the project area, "weave" length, low speed on Exit 36 southbound on ramp, congestion on Exit 36 northbound on ramp and southbound off ramp, property impacts, wetland impacts, stream crossings, cost, and funding. One alternative addressed some of the interstate capacity issues but would not meet the project purpose and need. Another alternative that would reconfigure Exit 36 to extend I-195 to Route 112 had the potential to improve traffic conditions at most of the study area intersections. However, this alternative was prohibitively expensive and would result in substantial impacts to the environment by requiring development of a new, approximately 0.9 mile long "greenfield" highway corridor across undeveloped and low-density residential land. The

selected alternative was determined to best meet the project purpose with minor impacts to property. Given the location of the protected natural resources on the project site, impacts to freshwater wetlands and the stream cannot be avoided.

B. Minimal Alteration. In support of an application and to address the analysis of the reasonableness of any impacts of a proposed project, an applicant must demonstrate that the amount of freshwater wetland and stream to be altered will be kept to the minimum amount necessary for meeting the overall purpose of the project. The applicant minimized impacts to wetlands by eliminating the northbound C-D roadway, by maintaining one-lane configurations for the Exit 36 northbound on ramp and southbound off ramp, by steepening side slopes from 6H:1V and 4H:1V to 3H:1V and 2H:1V with guardrails in wetland areas, by using a headwall to reduce the culvert extension and provide protection for Goosefare Brook and associated wetland, by revising the Exit 35 southbound ramp profile from 2% to 4% to reduce impacts to Wetland W09, by maintaining existing slopes along Wetlands W11 and W22, by extending guardrails for steeper slopes, and by revising the administrative building site to avoid additional wetland fill. Based on these design changes, the Department finds that the applicant has minimized wetland impacts for the proposed project.

C. Compensation. In accordance with Chapter 310, § 5(C)(6)(a) and (d), compensation is required to achieve the goal of no net loss of freshwater wetland and stream functions and values. The application included a functional assessment (Assessment) prepared by the applicant. The assessment identified the primary functions of the streams and associated wetlands to be groundwater recharge/discharge, floodflow alteration, sediment/toxicant retention, nutrient removal/retention/transformation, and wildlife habitat. Other wetland functions and values within the areas of the proposed impacts are absent or are provided at very low levels. The Assessment notes that approximately 40% of the assessed wetlands' primary role is to provide sediment /toxicant retention and nutrient removal, retention, transformation due to the proximity to existing development, including the Turnpike corridor and adjacent residential/commercial developments. The Assessment also states that most of the wetland assessed are limited in providing production export due to having been previously altered and cut off form wetlands in larger tracts of undeveloped land. The applicant noted that, while wetland functions currently provided by the wetland systems within the project area will remain intact subsequent to project construction, there will be localized impacts in the locations of the proposed permanent fill and grading.

The application included a table that identified the wetland types, their functions and values, the types of impact, and a calculation of an In-Lieu Fee payment amount for the wetland impacts from the proposed project. The majority of wetlands were identified as emergent wet meadow along the Turnpike corridor, some of which are routinely altered (mowed) as part of the applicant's management program to maintain highway clear zones. To compensate for the loss of functions and values of the wetlands, the applicant proposes to make a contribution into the In-Lieu Fee program of the Maine Natural Resource Conservation Program in the amount of $685,288. Prior to the start of construction, the applicant must submit a payment in the amount of $685,288 payable to

"Treasurer, State of Maine", and directed to the attention of the In-Lieu Fee Program Administrator at 17 State House Station, Augusta, Maine 04333.

The Department finds that the applicant has avoided and minimized stream and wetland impacts to the greatest extent practicable, and that the proposed project represents the least environmentally damaging alternative that meets the overall purpose of the project provided that prior to project construction, the applicant submits the In-Lieu Fee payment as described above.

The Department further finds that the activity will not unreasonably harm any freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine or marine fisheries or other aquatic life.

7. OTHER CONSIDERATIONS:

The Department finds, based on the design, proposed construction methods, and location, the proposed project will not inhibit the natural transfer of soil from the terrestrial to the marine environment, will not interfere with the natural flow of any surface or subsurface waters, and will not cause or increase flooding. The proposed project is not located in a coastal sand dune system, is not a crossing of an outstanding river segment, and does not involve dredge spoils disposal or the transport of dredge spoils by water.

The proposed project is also exempt from review under the Stormwater Management Law pursuant to 38 M.R.S. § 420-D(7)(G), as long as the project is constructed in accordance with the MOA referenced in Finding 5. The MOA requires that projects developed by the applicant located within watersheds of urban impaired streams must meet the General Standards contained in Chapter 500 *Stormwater Management Rules* (06-096 C.M.R. ch. 500, effective August 12, 2015) to the extent practicable. The applicant and the Department met to discuss stormwater treatment measures that will be implemented during construction of the proposed project.

Given the nature of the project and the applicant's intent to comply with the MOA referenced above to the extent practicable, the Department is satisfied that the proposed project complies with the General Standards of Chapter 500.

BASED on the above findings of fact, and subject to the conditions listed below, the Department makes the following conclusions pursuant to 38 M.R.S. §§ 480-A–480-JJ and Section 401 of the Clean Water Act (33 U.S.C. § 1341):

A. The proposed activity will not unreasonably interfere with existing scenic, aesthetic, recreational, or navigational uses.

B. The proposed activity will not cause unreasonable erosion of soil or sediment.

C. The proposed activity will not unreasonably inhibit the natural transfer of soil from the terrestrial to the marine or freshwater environment.

D. The proposed activity will not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine, or marine fisheries or other aquatic life provided that instream work window is limited to the period of June 1 to September 30, as described in Finding 4; and that the applicant plants, inspects and monitors the stream relocation and wetland riparian areas and submits the In-Lieu Fee as described in Finding 6.

E. The proposed activity will not unreasonably interfere with the natural flow of any surface or subsurface waters.

F. The proposed activity will not violate any state water quality law including those governing the classifications of the State's waters.

G. The proposed activity will not unreasonably cause or increase the flooding of the alteration area or adjacent properties.

H. The proposed activity is not on or adjacent to a sand dune.

I. The proposed activity is not on an outstanding river segment as noted in 38 M.R.S. § 480-P.

THEREFORE, the Department APPROVES the above noted application of the MAINE TURNPIKE AUTHORITY to improve Interstate 95 (Turnpike) Exit 36 and construct a new Exit 35 in the City of Saco, as described in Finding 1, SUBJECT TO THE ATTACHED CONDITIONS, and all applicable standards and regulations:

1. Standard Conditions of Approval, a copy attached.

2. The applicant shall take all necessary measures to ensure that its activities or those of its agents do not result in measurable erosion of soil on the site during the construction of the project covered by this approval.

3. Severability. The invalidity or unenforceability of any provision, or part thereof, of this License shall not affect the remainder of the provision or any other provisions. This License shall be construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.

4. The applicant must plant replant and include saplings and shrub plantings in the regraded riparian floodplain along Goosefare Brook to be maintained at an 80% survival rate for two years following installation.

5. The applicant shall limit instream work in Goosefare Brook to the period of June 1 to September 30.

6. Prior to the start of construction, the applicant shall submit a payment in the amount of $685,288 payable to "Treasurer, State of Maine", and directed to the attention of the In-Lieu Fee Program Administrator at 17 State House Station, Augusta, Maine 04333.

THIS APPROVAL DOES NOT CONSTITUTE OR SUBSTITUTE FOR ANY OTHER REQUIRED STATE, FEDERAL OR LOCAL APPROVALS NOR DOES IT VERIFY COMPLIANCE WITH ANY APPLICABLE SHORELAND ZONING ORDINANCES.

DONE AND DATED IN AUGUSTA, MAINE, THIS 14th DAY OF SEPTEMBER 2022.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

CORRECTING THE ORDER DATED JULY 22, 2022. The effective and expiration dates remain the same as in the original order.

BY: _____
For: Melanie Loyzim, Commissioner

PLEASE NOTE THE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES.

AJS/L29582ANBN/ATS#88524, 89836

FILED
September 15th, 2022
State of Maine
Board of Environmental Protection

Natural Resources Protection Act (NRPA)
Standard Conditions

THE FOLLOWING STANDARD CONDITIONS SHALL APPLY TO ALL PERMITS GRANTED UNDER THE NATURAL RESOURCES PROTECTION ACT, 38 M.R.S. §§ 480-A ET SEQ., UNLESS OTHERWISE SPECIFICALLY STATED IN THE PERMIT.

A. Approval of Variations From Plans. The granting of this permit is dependent upon and limited to the proposals and plans contained in the application and supporting documents submitted and affirmed to by the applicant. Any variation from these plans, proposals, and supporting documents is subject to review and approval prior to implementation.

B. Compliance With All Applicable Laws. The applicant shall secure and comply with all applicable federal, state, and local licenses, permits, authorizations, conditions, agreements, and orders prior to or during construction and operation, as appropriate.

C. Erosion Control. The applicant shall take all necessary measures to ensure that his activities or those of his agents do not result in measurable erosion of soils on the site during the construction and operation of the project covered by this Approval.

D. Compliance With Conditions. Should the project be found, at any time, not to be in compliance with any of the Conditions of this Approval, or should the applicant construct or operate this development in any way other the specified in the Application or Supporting Documents, as modified by the Conditions of this Approval, then the terms of this Approval shall be considered to have been violated.

E. Time frame for approvals. If construction or operation of the activity is not begun within four years, this permit shall lapse and the applicant shall reapply to the Board for a new permit. The applicant may not begin construction or operation of the activity until a new permit is granted. Reapplications for permits may include information submitted in the initial application by reference. This approval, if construction is begun within the four-year time frame, is valid for seven years. If construction is not completed within the seven-year time frame, the applicant must reapply for, and receive, approval prior to continuing construction.

F. No Construction Equipment Below High Water. No construction equipment used in the undertaking of an approved activity is allowed below the mean high water line unless otherwise specified by this permit.

G. Permit Included In Contract Bids. A copy of this permit must be included in or attached to all contract bid specifications for the approved activity.

H. Permit Shown To Contractor. Work done by a contractor pursuant to this permit shall not begin before the contractor has been shown by the applicant a copy of this permit.

DEP INFORMATION SHEET

Appealing a Department Licensing Decision

Dated: August 2021 **Contact: (207) 314-1458**

SUMMARY

This document provides information regarding a person's rights and obligations in filing an administrative or judicial appeal of a licensing decision made by the Department of Environmental Protection's (DEP) Commissioner.

Except as provided below, there are two methods available to an aggrieved person seeking to appeal a licensing decision made by the DEP Commissioner: (1) an administrative process before the Board of Environmental Protection (Board); or (2) a judicial process before Maine's Superior Court. An aggrieved person seeking review of a licensing decision over which the Board had original jurisdiction may seek judicial review in Maine's Superior Court.

A judicial appeal of final action by the Commissioner or the Board regarding an application for an expedited wind energy development (35-A M.R.S. § 3451(4)) or a general permit for an offshore wind energy demonstration project (38 M.R.S. § 480-HH(1)) or a general permit for a tidal energy demonstration project (38 M.R.S. § 636-A) must be taken to the Supreme Judicial Court sitting as the Law Court.

I. ADMINISTRATIVE APPEALS TO THE BOARD

LEGAL REFERENCES

A person filing an appeal with the Board should review Organization and Powers, 38 M.R.S. §§ 341-D(4) and 346; the Maine Administrative Procedure Act, 5 M.R.S. § 11001; and the DEP's *Rule Concerning the Processing of Applications and Other Administrative Matters* (Chapter 2), 06-096 C.M.R. ch. 2.

DEADLINE TO SUBMIT AN APPEAL TO THE BOARD

Not more than 30 days following the filing of a license decision by the Commissioner with the Board, an aggrieved person may appeal to the Board for review of the Commissioner's decision. The filing of an appeal with the Board, in care of the Board Clerk, is complete when the Board receives the submission by the close of business on the due date (5:00 p.m. on the 30th calendar day from which the Commissioner's decision was filed with the Board, as determined by the received time stamp on the document or electronic mail). Appeals filed after 5:00 p.m. on the 30th calendar day from which the Commissioner's decision was filed with the Board will be dismissed as untimely, absent a showing of good cause.

HOW TO SUBMIT AN APPEAL TO THE BOARD

An appeal to the Board may be submitted via postal mail or electronic mail and must contain all signatures and required appeal contents. An electronic filing must contain the scanned original signature of the appellant(s). The appeal documents must be sent to the following address.

Chair, Board of Environmental Protection
c/o Board Clerk
17 State House Station
Augusta, ME 04333-0017
ruth.a.burke@maine.gov

The DEP may also request the submittal of the original signed paper appeal documents when the appeal is filed electronically. The risk of material not being received in a timely manner is on the sender, regardless of the method used.

At the time an appeal is filed with the Board, the appellant must send a copy of the appeal to: (1) the Commissioner of the DEP (Maine Department of Environmental Protection, 17 State House Station, Augusta, Maine 04333-0017); (2) the licensee; and if a hearing was held on the application, (3) any intervenors in that hearing proceeding. **Please contact the DEP at 207-287-7688 with questions or for contact information regarding a specific licensing decision.**

REQUIRED APPEAL CONTENTS

A complete appeal must contain the following information at the time the appeal is submitted.

1. *Aggrieved status.* The appeal must explain how the appellant has standing to bring the appeal. This requires an explanation of how the appellant may suffer a particularized injury as a result of the Commissioner's decision.
2. *The findings, conclusions, or conditions objected to or believed to be in error.* The appeal must identify the specific findings of fact, conclusions of law, license conditions, or other aspects of the written license decision or of the license review process that the appellant objects to or believes to be in error.
3. *The basis of the objections or challenge.* For the objections identified in Item #2, the appeal must state why the appellant believes that the license decision is incorrect and should be modified or reversed. If possible, the appeal should cite specific evidence in the record or specific licensing criteria that the appellant believes were not properly considered or fully addressed.
4. *The remedy sought.* This can range from reversal of the Commissioner's decision on the license to changes in specific license conditions.
5. *All the matters to be contested*. The Board will limit its consideration to those matters specifically raised in the written notice of appeal.
6. *Request for hearing.* If the appellant wishes the Board to hold a public hearing on the appeal, a request for hearing must be filed as part of the notice of appeal, and it must include an offer of proof regarding the testimony and other evidence that would be presented at the hearing. The offer of proof must consist of a statement of the substance of the evidence, its relevance to the issues on appeal, and whether any witnesses would testify. The Board will hear the arguments in favor of and in opposition to a hearing on the appeal and the presentations on the merits of an appeal at a regularly scheduled meeting. If the Board decides to hold a public hearing on an appeal, that hearing will then be scheduled for a later date.
7. *New or additional evidence to be offered.* If an appellant wants to provide evidence not previously provided to DEP staff during the DEP's review of the application, the request and the proposed supplemental evidence must be submitted with the appeal. The Board may allow new or additional evidence to be considered in an appeal only under limited circumstances. The proposed supplemental evidence must be relevant and material, and (a) the person seeking to add information to the record must show due diligence in bringing the evidence to the DEP's attention at the earliest possible time in the licensing process; or (b) the evidence itself must be newly discovered and therefore unable to have been presented earlier in the process. Requirements for supplemental evidence are set forth in Chapter 2 § 24.

OTHER CONSIDERATIONS IN APPEALING A DECISION TO THE BOARD

1. *Be familiar with all relevant material in the DEP record.* A license application file is public information, subject to any applicable statutory exceptions, and is made accessible by the DEP. Upon request, the DEP will make application materials available to review and photocopy during normal working hours. There may be a charge for copies or copying services.

2. *Be familiar with the regulations and laws under which the application was processed, and the procedural rules governing the appeal.* DEP staff will provide this information upon request and answer general questions regarding the appeal process.

3. *The filing of an appeal does not operate as a stay to any decision.* If a license has been granted and it has been appealed, the license normally remains in effect pending the processing of the appeal. Unless a stay of the decision is requested and granted, a licensee may proceed with a project pending the outcome of an appeal, but the licensee runs the risk of the decision being reversed or modified as a result of the appeal.

WHAT TO EXPECT ONCE YOU FILE A TIMELY APPEAL WITH THE BOARD

The Board will acknowledge receipt of an appeal, and it will provide the name of the DEP project manager assigned to the specific appeal. The notice of appeal, any materials admitted by the Board as supplementary evidence, any materials admitted in response to the appeal, relevant excerpts from the DEP's administrative record for the application, and the DEP staff's recommendation, in the form of a proposed Board Order, will be provided to Board members. The appellant, the licensee, and parties of record are notified in advance of the date set for the Board's consideration of an appeal or request for a hearing. The appellant and the licensee will have an opportunity to address the Board at the Board meeting. The Board will decide whether to hold a hearing on appeal when one is requested before deciding the merits of the appeal. The Board's decision on appeal may be to affirm all or part, affirm with conditions, order a hearing to be held as expeditiously as possible, reverse all or part of the decision of the Commissioner, or remand the matter to the Commissioner for further proceedings. The Board will notify the appellant, the licensee, and parties of record of its decision on appeal.

II. JUDICIAL APPEALS

Maine law generally allows aggrieved persons to appeal final Commissioner or Board licensing decisions to Maine's Superior Court (see 38 M.R.S. § 346(1); 06-096 C.M.R. ch. 2; 5 M.R.S. § 11001; and M.R. Civ. P. 80C). A party's appeal must be filed with the Superior Court within 30 days of receipt of notice of the Board's or the Commissioner's decision. For any other person, an appeal must be filed within 40 days of the date the decision was rendered. An appeal to court of a license decision regarding an expedited wind energy development, a general permit for an offshore wind energy demonstration project, or a general permit for a tidal energy demonstration project may only be taken directly to the Maine Supreme Judicial Court. See 38 M.R.S. § 346(4).

Maine's Administrative Procedure Act, DEP statutes governing a particular matter, and the Maine Rules of Civil Procedure must be consulted for the substantive and procedural details applicable to judicial appeals.

ADDITIONAL INFORMATION

If you have questions or need additional information on the appeal process, for administrative appeals contact the Board Clerk at 207-287-2811 or the Board Executive Analyst at 207-314-1458 bill.hinkel@maine.gov, or for judicial appeals contact the court clerk's office in which the appeal will be filed.

Note: This information sheet, in conjunction with a review of the statutory and regulatory provisions referred to herein, is provided to help a person to understand their rights and obligations in filing an administrative or judicial appeal. The DEP provides this information sheet for general guidance only; it is not intended for use as a legal reference. Maine law governs an appellant's rights.

APPENDIX H

US Army Corps of Engineers Individual Permit

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

September 15, 2022

Regulatory Division
File No. NAE-2021-03072

Sean Donohue
Maine Turnpike Authority
2360 Congress Street
Portland, Maine 04102
via email: sdonohue@maineturnpike.com

Mr. Donohue:

Enclosed is the validated standard Department of the Army permit authorizing your project.

You are required to complete and return the enclosed forms to this office:

1. Work Start Notification Form at least two weeks before the anticipated work start date.
2. Compliance Certification Form within one month following the completion of the authorized work.

This permit is a limited authorization containing a specific set of conditions. Please read the permit thoroughly to familiarize yourself with those conditions, **including any conditions contained on the enclosed state water quality certification.** If a contractor does the work for you, both you and the contractor are responsible for ensuring that the work is done in compliance with the permit's terms and conditions, as any violations could result in civil or criminal penalties.

We continually strive to improve our customer service. In order for us to better serve you, we would appreciate your completing our Customer Service Survey located at https://regulatory.ops.usace.army.mil/customer-service-survey/.

If you have any questions regarding this correspondence, please contact Colin Greenan at 978-318-8676 or colin.m.greenan@usace.army.mil at our Augusta, Maine Project Office.

Sincerely,

Frank J. Del Giudice
Chief, Permits and Enforcement Branch
Regulatory Division

Enclosures

cc:
Mike Marsh, U.S. Environmental Protection Agency, marsh.mike@epa.gov
Alison Sirois, Maine Department of Environmental Protection, alison.sirois@maine.gov

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant:	File Number:	Date:
Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/appeals.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

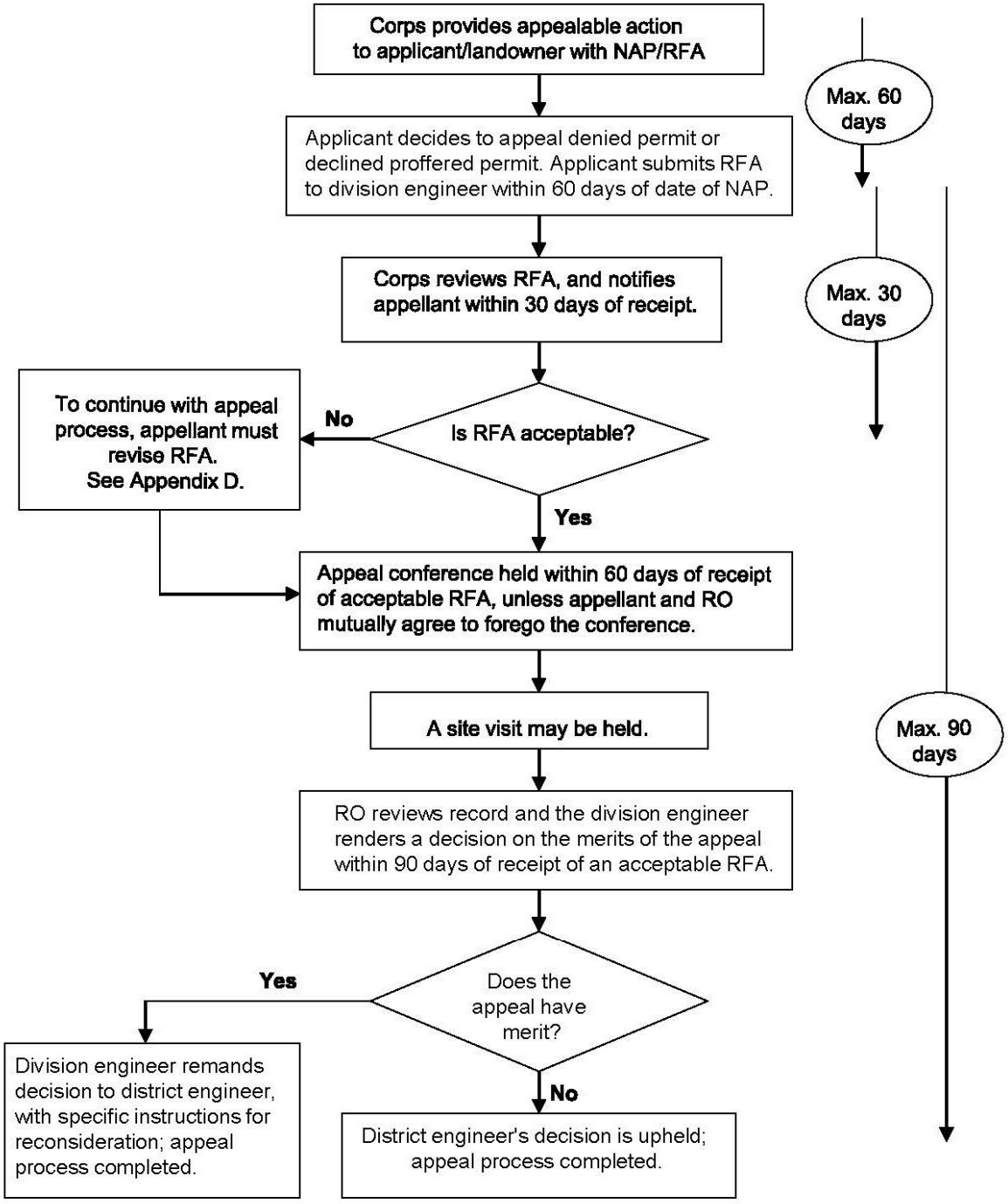
ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:	
If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact: Mr. James W. Haggerty Regulatory Program Manager (CENAD-PD-OR) U.S. Army Corps of Engineers Fort Hamilton Military Community 301 General Lee Avenue Brooklyn, New York 11252-6700 Telephone number: 347-370-4650

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_____ Signature of appellant or agent.	Date:	Telephone number:

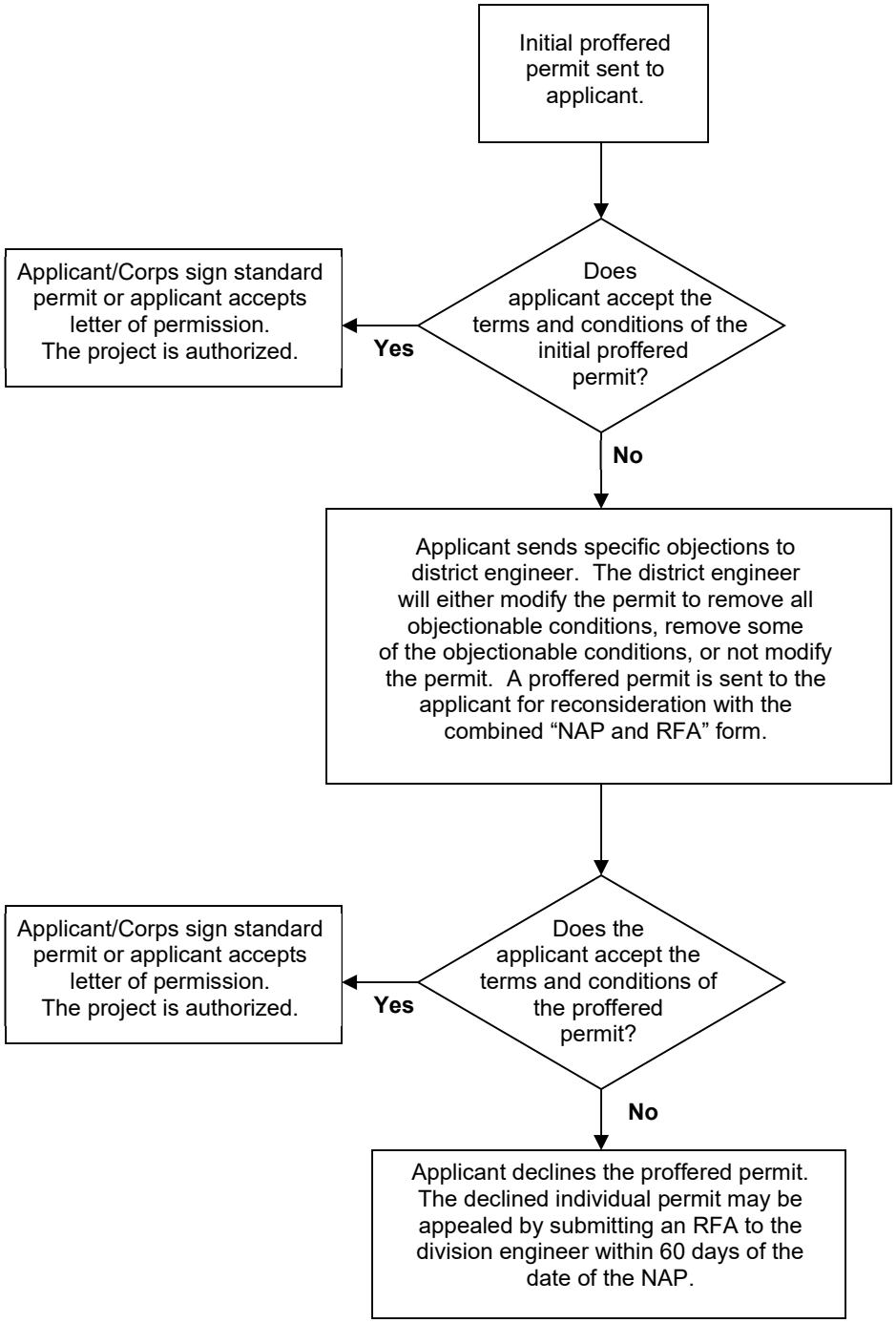
Administrative Appeal Process for Permit Denials and Proffered Permits



NOTE: If new information is provided to the Corps, the applicant will be asked if the applicant wishes to revise the project or record. If so, the appeal will be withdrawn and the case returned to the District for appropriate action. If not, then the Division Engineer will rule on the merits of the appeal based on the administrative record without consideration of the new information. However, the new information may cause the District Engineer to take action under 33 CFR 325.7, independent of the appeal process.

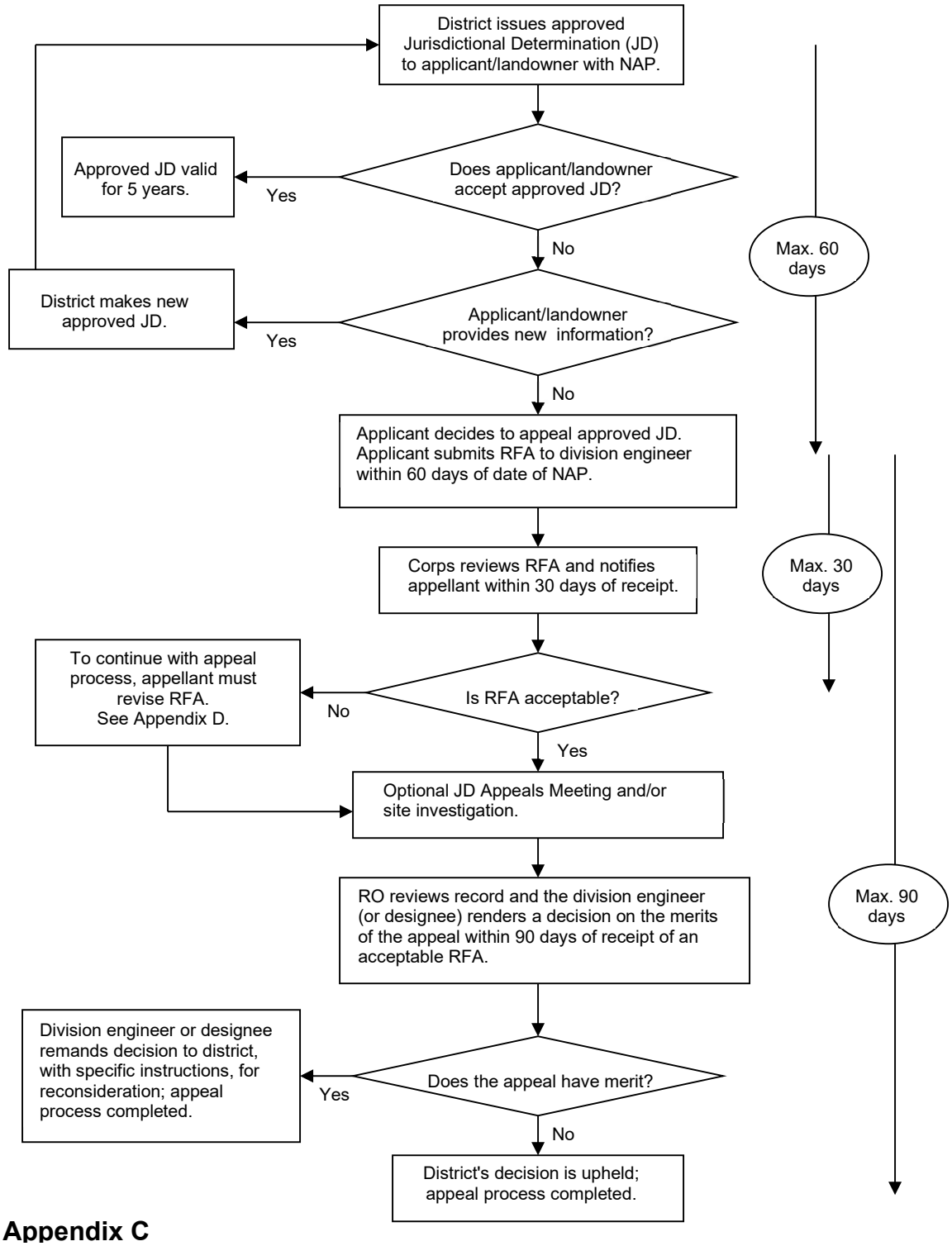
Appendix A

Applicant Options with Initial/Proffered Permit



Appendix B

Administrative Appeal Process for Approved Jurisdictional Determination



Appendix C

DEPARTMENT OF THE ARMY PERMIT

Permittee Maine Turnpike Authority - 2360 Congress Street, Portland, Maine 04102

Permit No. NAE-2021-03072

Issuing Office New England District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

Place temporary and permanent fill below the ordinary high water mark of Goosefare Brook and in adjacent freshwater wetlands at Saco, York County, Maine in order to make improvements to the Maine Turnpike's former Exit 5 and existing Exit 36 at Interstate 195. The work includes the reconstruction of the former Exit 5 northbound off- and on-ramps that currently only provide access to the "Ramada Inn" with a new direct connection to Route 112 and associated infrastructure for a new on-ramp toll plaza. The reconstruction of the former Exit 5 would result in a new exit, Exit 35. The existing connection to Lund Road (Ramada Inn) from Route 112 would be replaced with a new road located approximately 0.13 mile to the north (near the existing access to XL Sports Complex). New Exit 35 southbound off and on-ramps would be constructed to connect to Route 112 and would include associated infrastructure for a new on-ramp toll plaza and park and ride. The Turnpike's southbound roadway would be widened from north of Exit 36, south through Route 112 to provide for safer deceleration and acceleration to/from Exit 36 and the new Exit 35. An existing culvert that conveys Goosefare Brook beneath the Turnpike would be extended approximately 24 feet upstream and the brook would be shifted southwest to align with the inlet of the extension. The existing Exit 36 northbound off-ramp and southbound on-ramp would undergo minor realignments as a result of the improvements to Exit 35 and southbound roadway widening through Exit 36. This work will result in approximately 1,432 SF of permanent stream bed impact, and 3.02 acres of permanent and 0.20 acre of temporary freshwater wetland impact.

This work is shown on the enclosed plans entitled "Saco Interchange Reconfiguration Project" in one sheet dated "2020-02-12", "WETLAND & WATERCOURSE DELINATION MAP" in 25 sheets dated "NOVEMBER, 2021", and "GOOSEFARE BROOK CULVERT ENTENSION" in three sheets dated "6/10/2022".

Project Location:

Maine Turnpike (Interstate 95) from approximately 0.64 mi. south of Route 112 (North Street), north 2 miles to approximately 0.89 mi. north of Interstate 195 including the existing northbound "Ramada Inn" exit (formerly Exit 5) and existing Exit 36.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on December 31, 2027. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

1. You shall ensure that a copy of this permit is at the work site (and the project office) authorized by this permit whenever work is being performed, and that all personnel with operational control of the site ensure that all appropriate personnel performing work are fully aware of its terms and conditions. The entire permit shall be made a part of any and all contracts and sub-contracts for work that affects areas of Corps jurisdiction at the site of the work authorized by this permit. This shall be achieved by including the entire permit in the specifications for work. The term “entire permit” means this permit (including its drawings, plans, appendices and other attachments) and also includes permit modifications.

If the permit is issued after the construction specifications, but before receipt of bids or quotes, the entire permit shall be included as an addendum to the specifications. If the permit is issued after receipt of bids or quotes, the entire permit shall be included in the contract or sub-contract. Although you may assign various aspects of the work to different contractors or sub-contractors, all contractors and sub-contractors shall be obligated by contract to comply with all environmental protection provisions contained within the entire permit, and no contract or sub-contract shall require or allow unauthorized work in areas of Corps jurisdiction.

2. You shall comply with all of the terms and conditions of the attached permit and water quality certification from the Maine Department of Environmental Protection dated July 27, 2022.

3. Compensatory mitigation for unavoidable impacts to waters of the U.S. shall consist of purchasing 3.02-acre credit from the Maine Natural Resource Conservation Fund. As of the date of this permit, the current cost to purchase these credits is $682,126.89. The attached completed In-Lieu-Fee (ILF) Project Data Worksheet shall be mailed with a cashier's check or bank draft made out to "Treasurer, State of Maine", with Corps file number “NAE-2021-03072” and “For ILF accountant only” clearly noted on the check. The check and worksheet shall be mailed to Maine Department of Environmental Protection, Attention: ILF Program Administrator, 17 State House Station, Augusta, Maine 04333. **No impacts authorized by this permit shall begin until the Corps receives a copy of the letter from the Maine Department of Environmental Protection (MaineDEP) to the permittee stating that the MaineDEP has received the check and accepts responsibility for mitigation.** The in-lieu-fee amount is valid for one year from the date of this permit and is subject to change if not paid prior.

4. You shall complete and return the enclosed Work Start Notification Form to this office at least two weeks before the anticipated starting date.

5. In-stream construction work shall be conducted between June 1st and September 30th in any year in order to minimize potential impacts to aquatic resources and local water quality. In-stream construction work shall also be conducted “in the dry” using cofferdams, temporary flume pipes, culverts, etc. and downstream flows shall be maintained during in-stream construction.

6. Tree clearing shall be conducted between August 1st and May 31st in any year, as practicable in order to minimize potential effects to the federally threatened northern long-eared bat.

7. Adequate sedimentation and erosion control management measures, practices and devices, such as phased construction, installation of sediment control barriers (i.e. silt fence, vegetated filter strips, geotextile silt fences, erosion control mixes, hay bales or other devices) downhill of all exposed areas, retention of existing vegetated buffers, application of temporary mulching during construction, and permanent seeding and stabilization shall be installed and properly maintained to reduce erosion and retain sediment on-site during and after construction. They shall be capable of preventing erosion; of collecting sediment, suspended and floating materials; and of filtering fine sediment. Temporary sediment control barriers shall be removed upon completion of work, but not until all disturbed areas are permanently stabilized. The sediment collected by these sediment barriers shall be removed and placed at an upland location and stabilized to prevent its later erosion into a waterway or wetland. All exposed soil and other fills shall be permanently stabilized at the earliest practicable date.

8. Temporary fills (e.g. access roads, cofferdams) shall not be placed in waters of the U.S. including wetlands unless specifically authorized by this permit. If temporary fill is used, it shall be disposed of at an upland site and suitably contained to prevent its subsequent erosion into a water of the U.S., and the impacted area shall be restored to its original contours (but not higher) and character upon completion of the project. During use, such temporary fill shall be stabilized to prevent erosion, or in the case of fill placed in flowing water (rivers or streams), clean washed stoned shall be used.

9. You shall complete and return the enclosed Compliance Certification Form to this office at least within one month following the completion of the authorized work.

10. Except where stated otherwise, reports, drawings, correspondence, and any other submittals required by this permit shall be marked with the words “Permit No. NAE-2021-03072”” and shall be addressed to “Inspection Section, CENAE-R, U.S. Army Corps of Engineers, 696 Virginia road, Concord, Massachusetts 01742-2751”. Documents which are not marked and addressed in this manner may not reach their intended destination and do not comply with the requirements of this permit.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
( ) Section 14 of the Rivers and Harbors Act of 1899 (33 U.S.C. 408).
(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).
( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from Natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interested decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

, For Maine Turnpike Authority — 09-14-2022

(Permittee) ***(Date)***

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

09-15-2022

Frank J. Del Giudice
Chief, Permits & Enforcement Branch
Regulatory Division
For: District Engineer

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(Transferee) ***(Date)***

MAINE IN-LIEU-FEE (ILF)
PROJECT IMPACT WORKSHEET

DEP Invoice # *Filled in by ILF Administrator in Augusta*

Project name: Exits 35 & 36 Interchange Improvements Project

Permittee(s): Maine Turnpike Authority

DEP/Corps permit #: L-29582-TG-A-N /NAE-2021-03072 *Attach a copy of the permit*

DEP/Corps Project Manager: Alison Sirois / Colin Greenan

ILF Fee Amount: 131,431 x ($4.70 + $0.49) = $682,126.89

Check Date: *Filled in by ILF Administrator in Augusta*

Project address: Maine Turnpike, Mile Marker 35-36, Saco *Attach a locus map*

Biophysical region - Section: Southern Maine

Biophysical region - Subsection: South Coastal Region

Total impact area subject to compensation: 131,431 SF (3.02 acre)

Resource(s) impacted:

Resource Types (list all that apply)	**Functions & Values** (for wetland impacts) (list all that apply, by resource type)	**Types of Impacts** (list all that apply, by resource type)	**SF Impacted** (by resource type)
PEM	GWR, FF, FSH, STR, SS, NR, WH	Permanent Fill / Grading	960
	GWR, FF, STR, NR, PE,WH		1,131
	GWR, FF, NR, PE,WH, R		1,490
	GWR, FF, STR, NR, WH		77,961
	GWR, STR, WH		1,662
	GWR,WH, R		3,871
	GWR, WH		4,356
	WH		12
PSS	GWR, FF, FSH, STR, SS, WH		24,420
	GWR, FF, FSH, STR, SS, NR, WH		1,462
	GWR, STR, SS, WH		7
PFO	GWR, FF, STR, NR, WH		13,926
	GWR, STR, WH		173
		Total impacts:	131,431

Resource Types: Wetlands by NWI Type (PEM, PFO, PSS, PUB, M1, M2, E1, E2, M1AB3*, etc), significant vernal pool depression (SVP), significant vernal pool critical terrestrial habitat (VPCTH), shorebird feeding & staging habitat (shorebird), inland waterfowl & wading bird habitat (IWWH), Tidal waterfowl & wading bird habitat (TWWH), lake or pond (L1, L2), river/stream/brook (RSB)
Wetland Functions & Values: Groundwater recharge/discharge (GWR); floodflow alteration (FF); fish & shellfish habitat (FSH); sediment toxicant retention (STR); nutrient removal (NR); production export (PE); sediment/shoreline stabilization (SS); recreation (R); education/scientific value (ESV); uniqueness/heritage (UH); and visual quality/aesthetics (VQ); wildlife habitat (WH)

Types of Impacts: May include: filling, dredging, vegetation conversion (e.g. forested to shrub/scrub), excavation with associated discharge, etc.

* Eelgrass or other subtidal aquatic vegetation

US Army Corps of Engineers ®
New England District

INDIVIDUAL PERMIT
WORK-START NOTIFICATION FORM
(Minimum Notice: Two weeks before work begins)

EMAIL THIS FORM TO: colin.m.greenan@usace.army.mil

A Corps of Engineers Permit (No. NAE-2021-003072) was issued to the Maine Turnpike Authority. The work is located along the Maine Turnpike from approximately 0.64 mi. south of Route 112 (North Street), north 2 miles to approximately 0.89 mi. north of Interstate 195 including the existing northbound "Ramada Inn" exit (formerly Exit 5) and existing Exit 36. The permit authorized the permittee to place temporary and permanent fill below the ordinary high water mark of Goosefare Brook and in adjacent freshwater wetlands at Saco, York County, Maine in order to make improvements to the Maine Turnpike's former Exit 5 and existing Exit 36 at Interstate 195.

The people (e.g., contractor) listed below will do the work, and they understand the permit's conditions and limitations.

PLEASE PRINT OR TYPE

Name of Person/Firm: _____

Business Address: _____

_____

_____

Telephone: (____) _____ (____) _____

Proposed Work Dates: Start: _____

Finish: _____

PERMITTEE'S SIGNATURE: _____ DATE: _____

PRINTED NAME: _____ TITLE: _____

FOR USE BY THE CORPS OF ENGINEERS

Project Manager: GREENAN Submittals Required: YES

Inspection Recommendation: inspect as convenient

US Army Corps of Engineers®
New England District

(Minimum Notice: Permittee must sign and return notification within one month of the completion of work.)

COMPLIANCE CERTIFICATION FORM

Corps Project Number: NAE-2021-03072

Name of Permittee: Maine Turnpike Authority

Permit Issuance Date: _____

Please sign this certification and return it to the following address upon completion of the activity and any mitigation required by the permit. You must submit this after the mitigation is complete, but not the mitigation monitoring, which requires separate submittals.

****
* MAIL TO: U.S. Army Corps of Engineers, New England District *
* Policy Analysis/Technical Support Branch, ATTN: Marie Farese *
* Regulatory Division *
* 696 Virginia Road *
* Concord, Massachusetts 01742-2751 *
****

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit was completed in accordance with the terms and conditions of the above referenced permit, and any required mitigation was completed in accordance with the permit conditions.

_____ _____

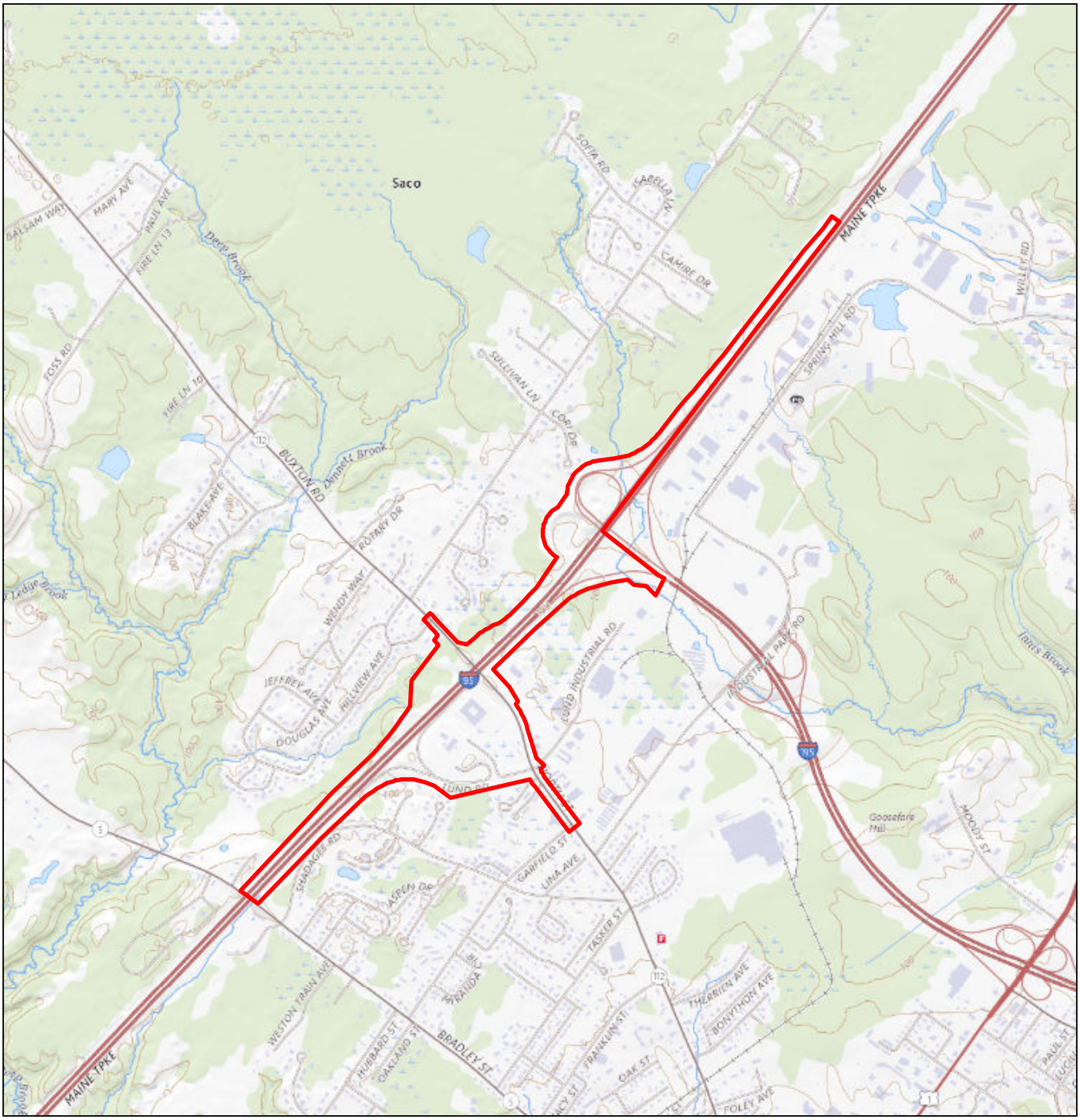
Signature of Permittee Date

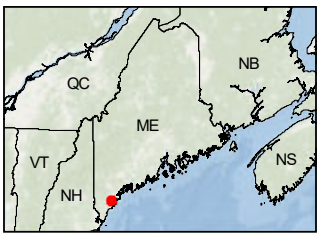
_____ _____

Printed Name Date of Work Completion

( ) _____

Telephone Number





Notes
1. Coordinate System: NAD 1983 StatePlane Maine West FIPS 1802 Feet
2. Background: USGS Topo provided by The National Map Mapping Service (https://basemap.nationalmap.gov/arcgis/services)

Legend
- Approximate Project Location
- USGS Quad: Old Orchard Beach

0 2,000 Feet
(At original document size of 8.5x11)
1:24,000

N

Stantec

Project Location
Saco, Maine

Prepared by REM on 2020-02-12
TR by KWH on 2020-02-12
IR Review by RDK on 2020-02-12

Client/Project 179450063
Maine Turnpike Authority
Exit 35 & 36
Saco, ME

Figure No.
1

Title
Saco Interchange Reconfiguration Project

V:\1956\active_Task Owner and other Non-BC\1956 Jobs\179450063\03_data\gis_cad\gis\MXDs\179450063_01_SiteLocation.mxd Revised: 2021-10-04 By: khoward

Filename: ..._WetlandImpactsIndexSheet.dgn Date: 11/12/2021

500 0 500 1000
Scale of Feet

Stantec

MAINE TURNPIKE

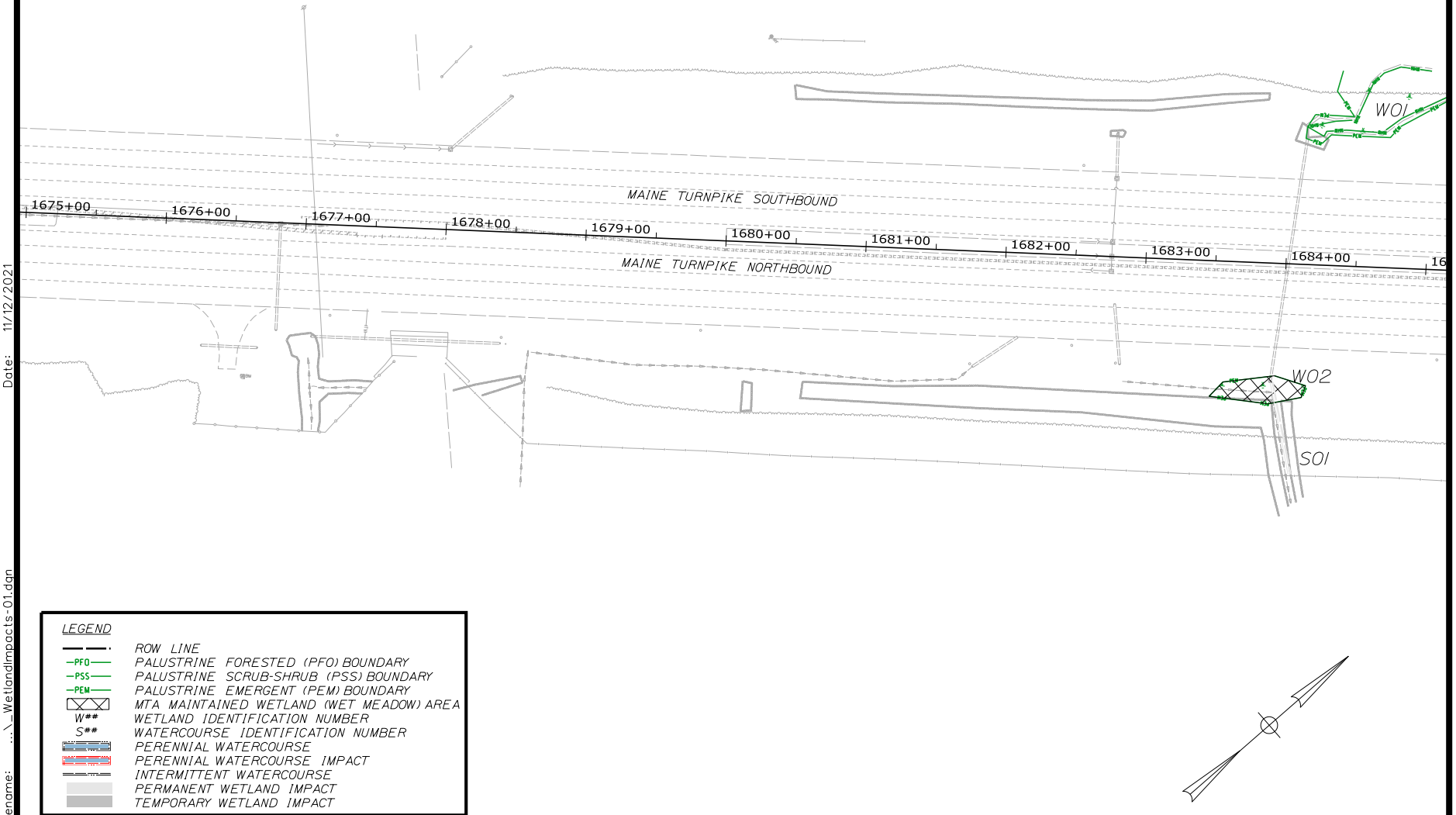
THE GOLD STAR
MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP INDEX PLAN

DATE: NOVEMBER, 2021

SHEET 1 OF 25



LEGEND

- ROW LINE
- PFO — PALUSTRINE FORESTED (PFO) BOUNDARY
- PSS — PALUSTRINE SCRUB-SHRUB (PSS) BOUNDARY
- PEM — PALUSTRINE EMERGENT (PEM) BOUNDARY
- MTA MAINTAINED WETLAND (WET MEADOW) AREA
- W## WETLAND IDENTIFICATION NUMBER
- S## WATERCOURSE IDENTIFICATION NUMBER
- PERENNIAL WATERCOURSE
- PERENNIAL WATERCOURSE IMPACT
- INTERMITTENT WATERCOURSE
- PERMANENT WETLAND IMPACT
- TEMPORARY WETLAND IMPACT

50 0 50 100
Scale of Feet

Stantec

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 1

DATE: NOVEMBER, 2021

SHEET 2 OF 25

Date: 11/12/2021

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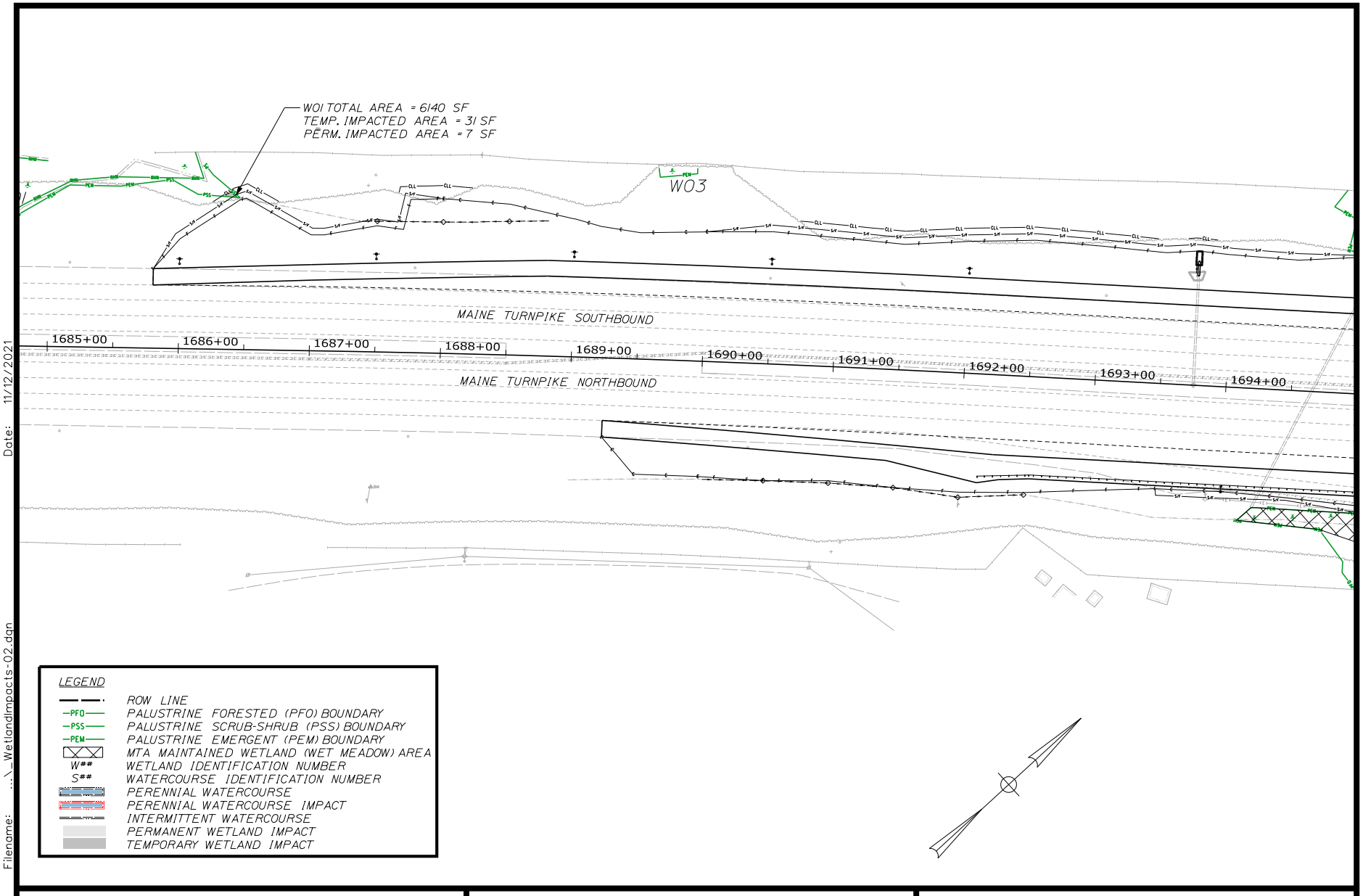

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50 0 50 100
Scale of Feet

Stantec

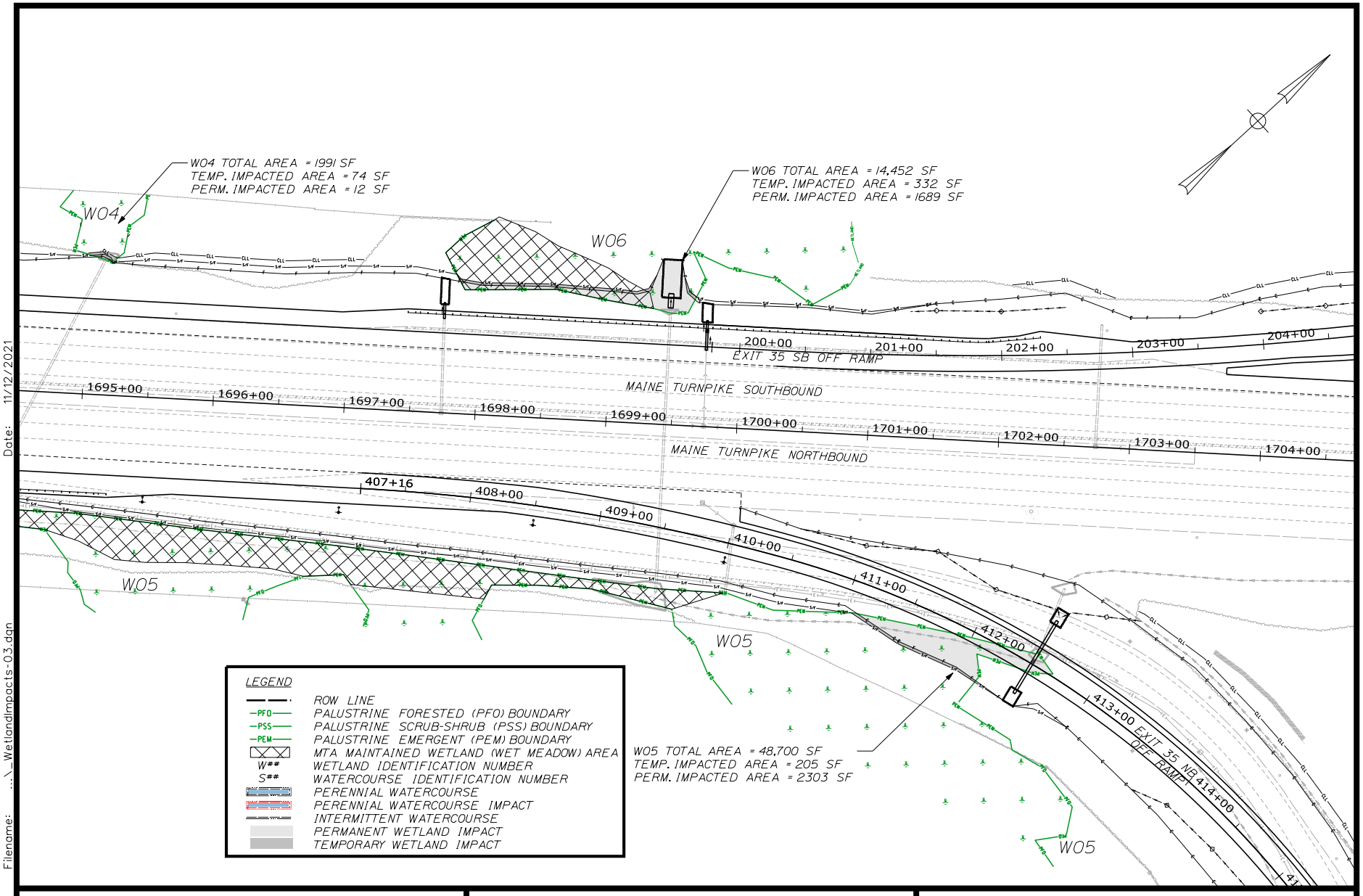
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 2

DATE: NOVEMBER, 2021



Filename: ..._WetlandImpacts-03.dgn Date: 11/12/2021

50 0 50 100
Scale of Feet

Stantec

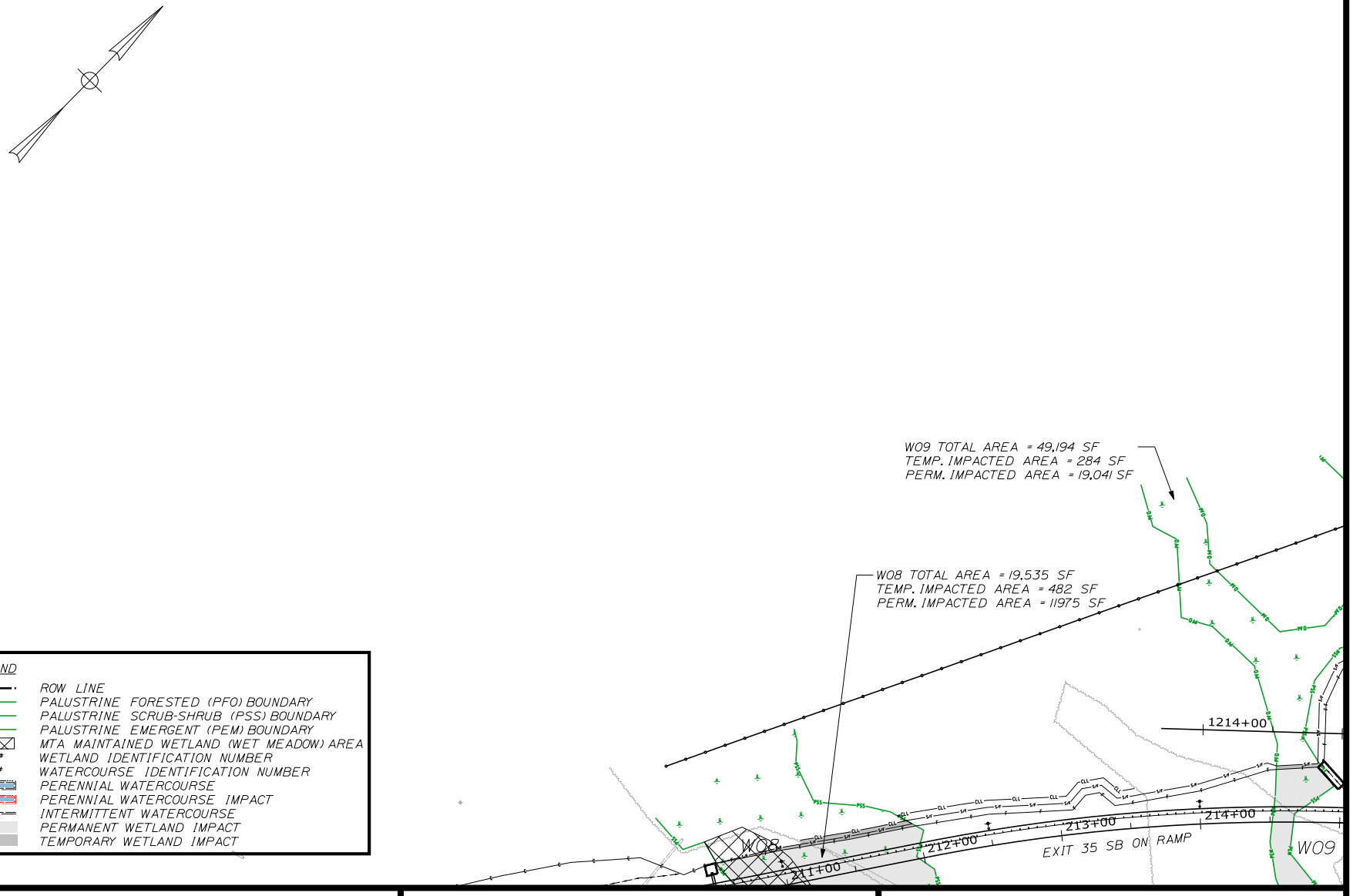
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 3

DATE: NOVEMBER, 2021



Filename: ..._WetlandImpacts-04.dgn Date: 11/12/2021

Stantec

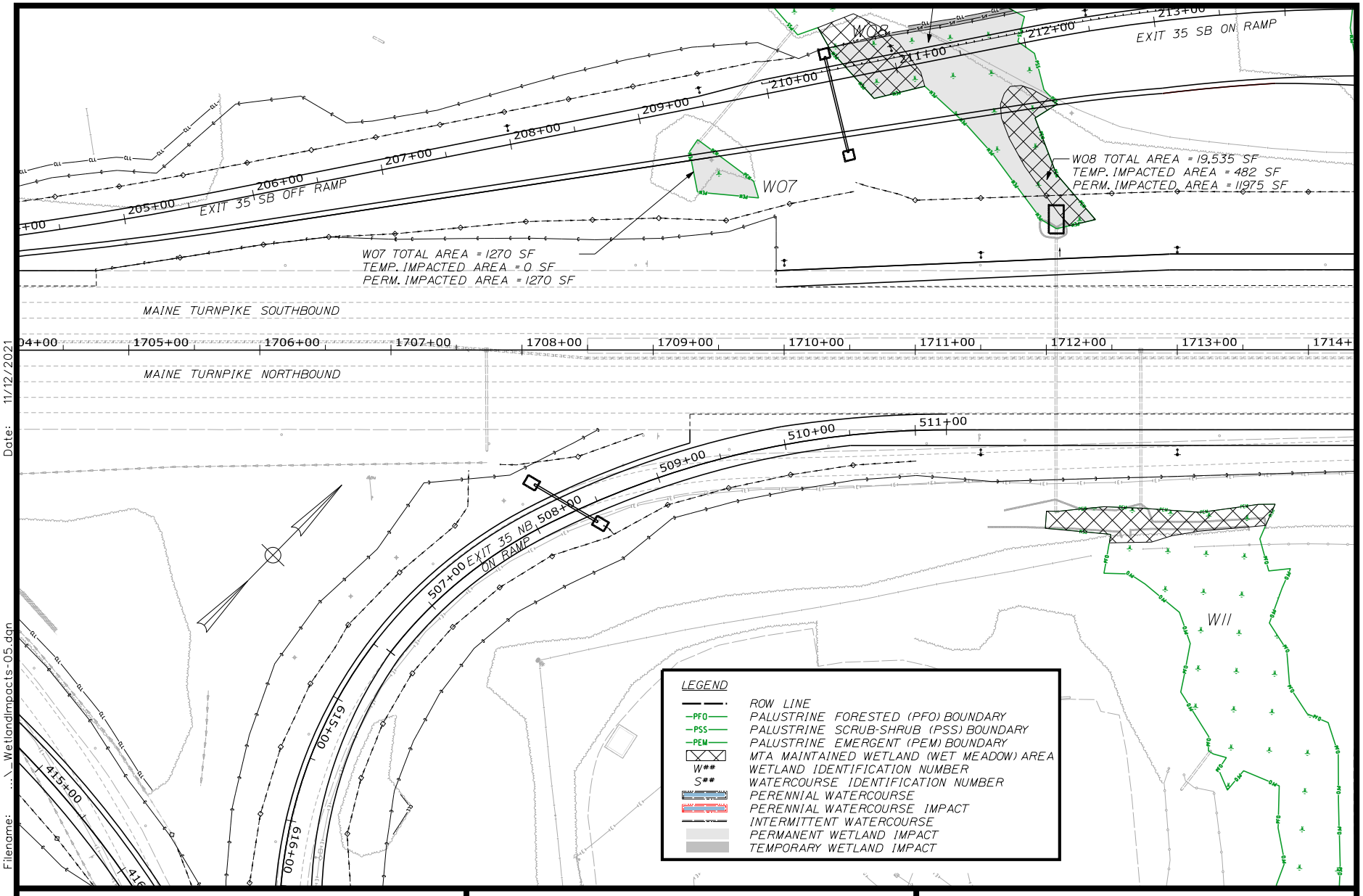
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 4

DATE: NOVEMBER, 2021



Date: 11/12/2021

Filename: ..._WetlandImpacts-05.dgn

50 0 50 100
Scale of Feet

Stantec

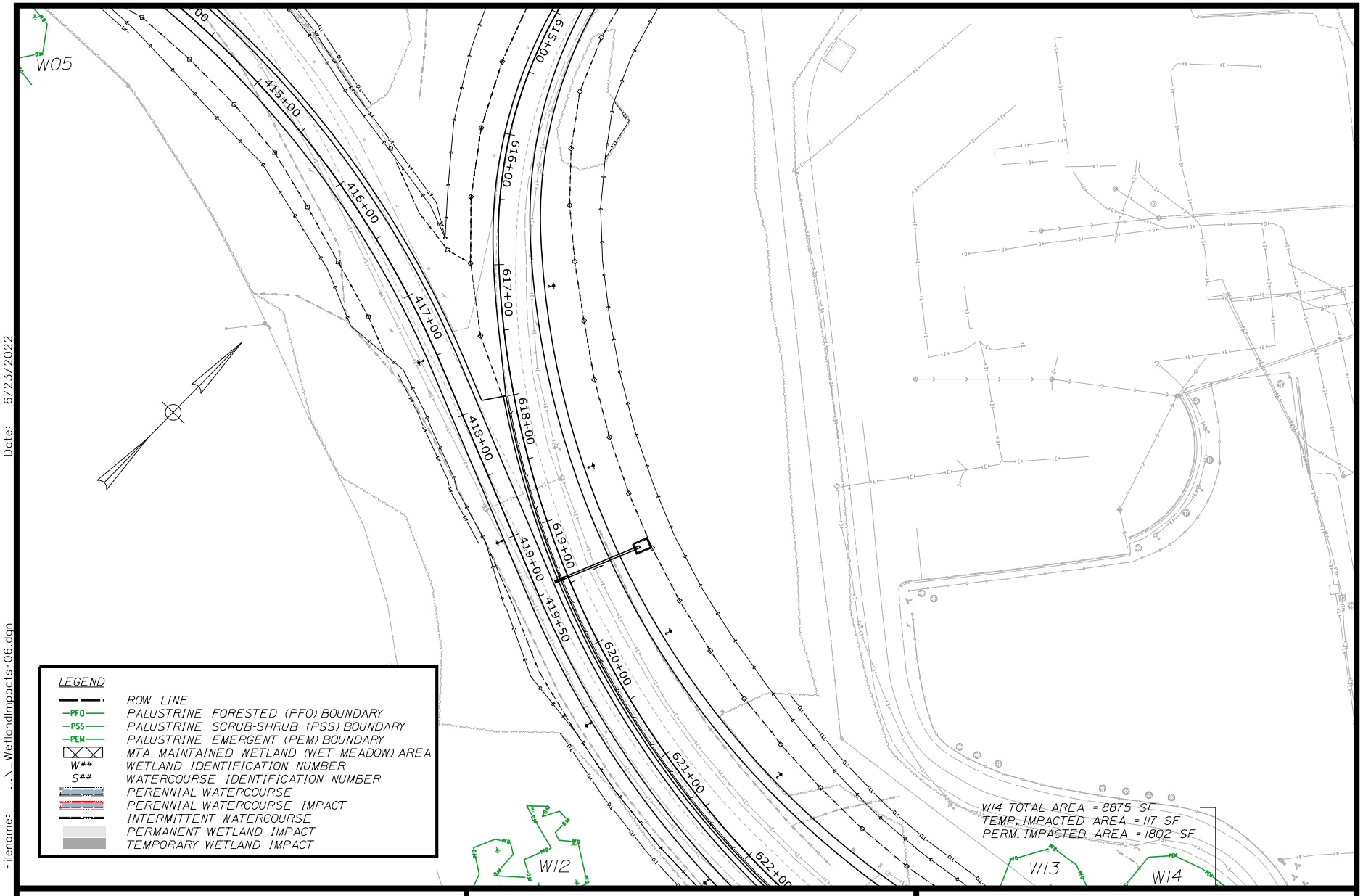
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 5

DATE: NOVEMBER, 2021



Filename: ..._WetlandImpacts-06.dgn Date: 6/23/2022

50 0 50 100
Scale of Feet

Stantec

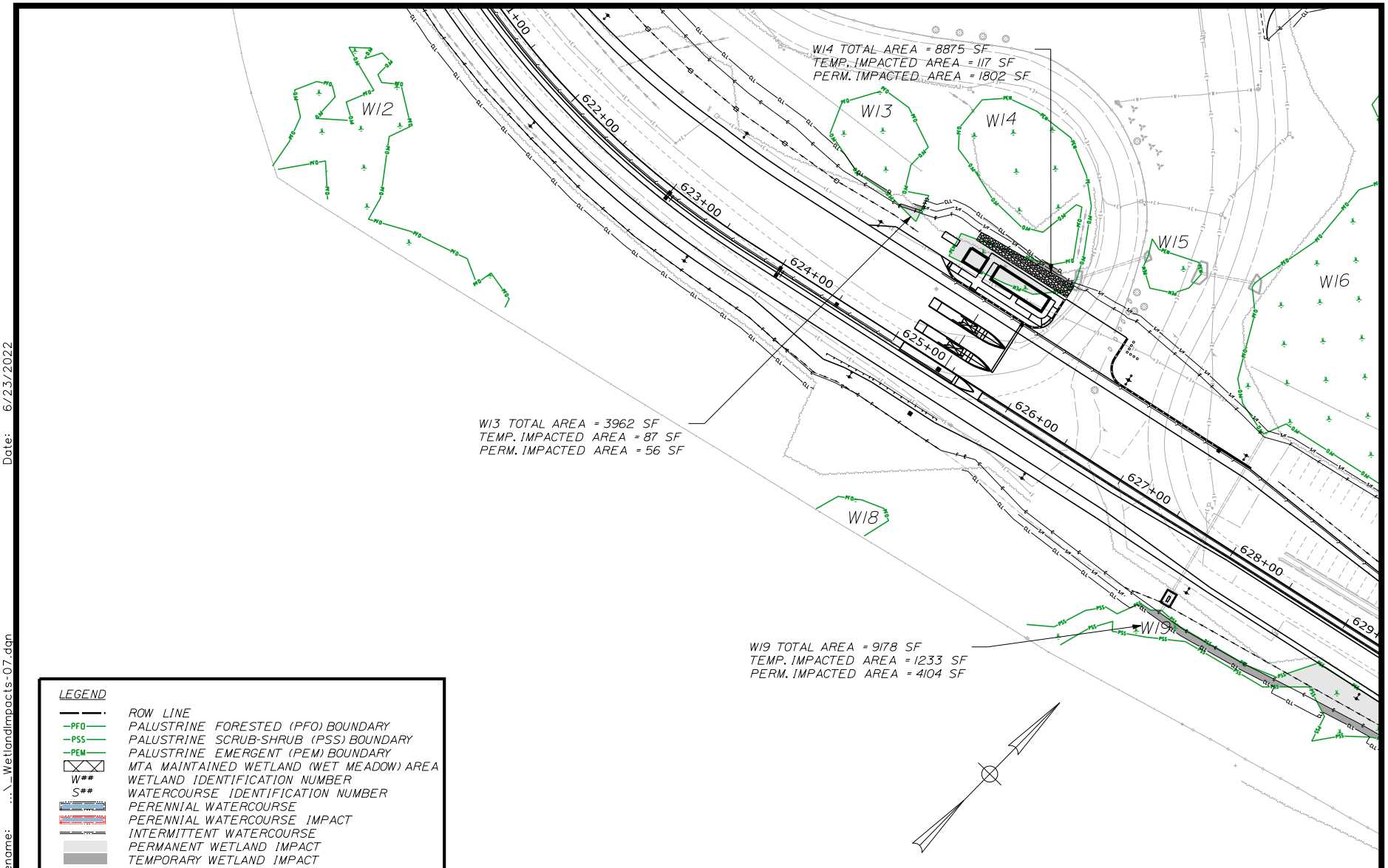
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 6

DATE: JUNE, 2022



Filename: ..._WetlandImpacts-07.dgn Date: 6/23/2022

50 0 50 100
Scale of Feet

Stantec

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

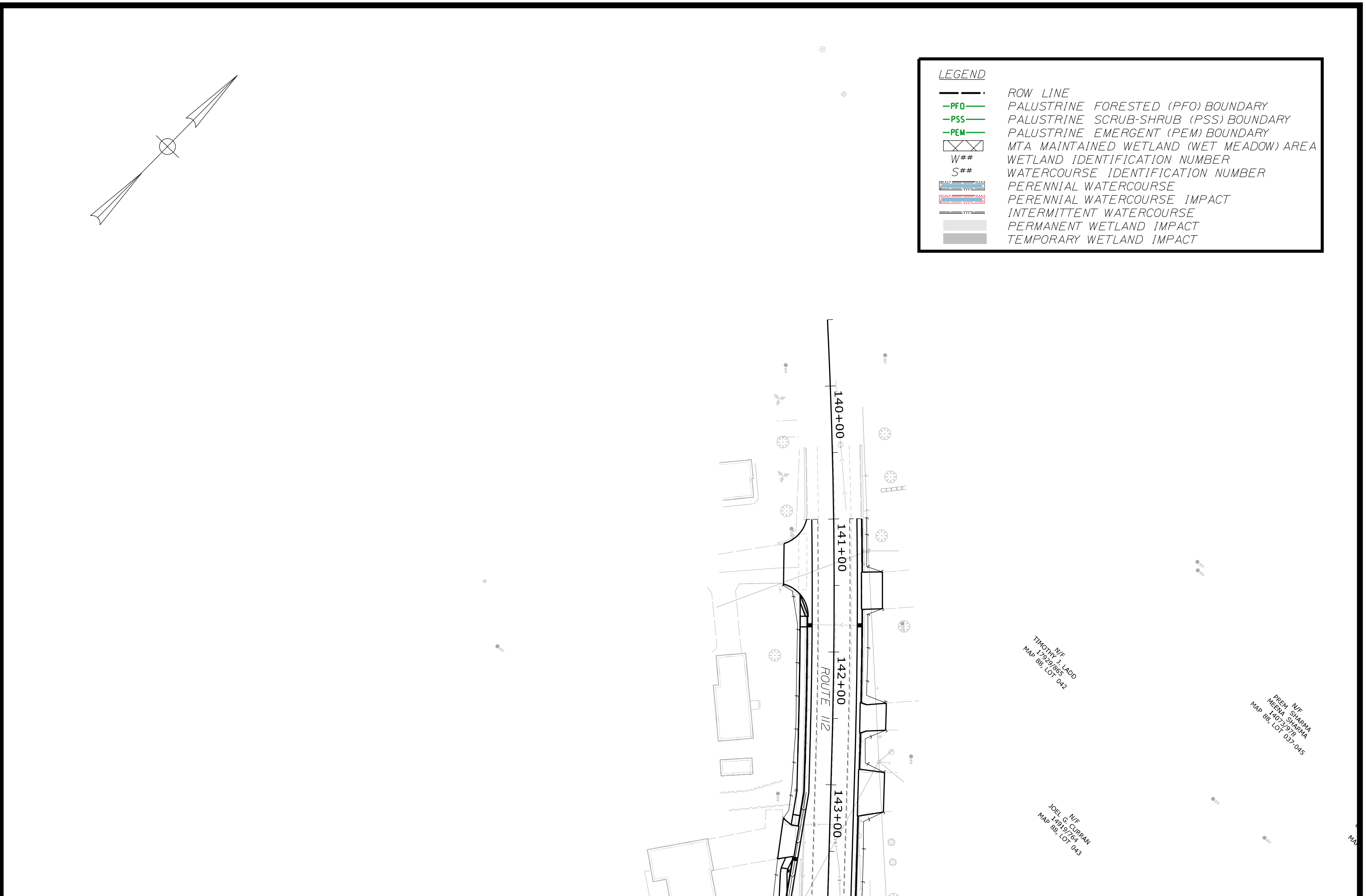
INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 7

DATE: JUNE, 2022

Date: 11/12/2021

Filename: ..._WetlandImpacts-08.dgn



50 0 50 100

Scale of Feet

Stantec

MAINE TURNPIKE

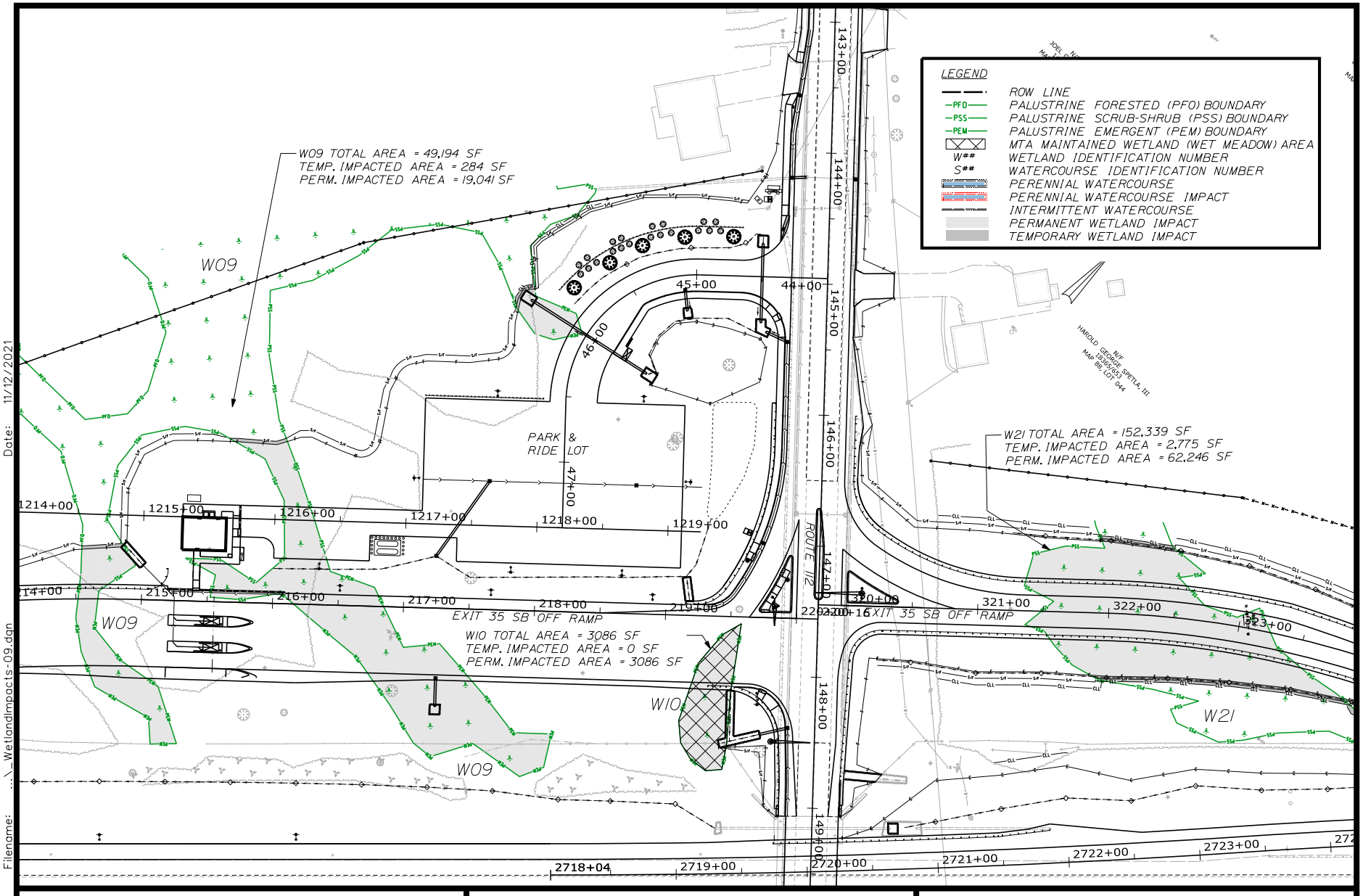
THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP
PLAN VIEW 8

DATE: NOVEMBER, 2021

SHEET 9 OF 25



Date: 11/12/2021

Filename: ..._WetlandImpacts-09.dgn

50 0 50 100
Scale of Feet

Stantec

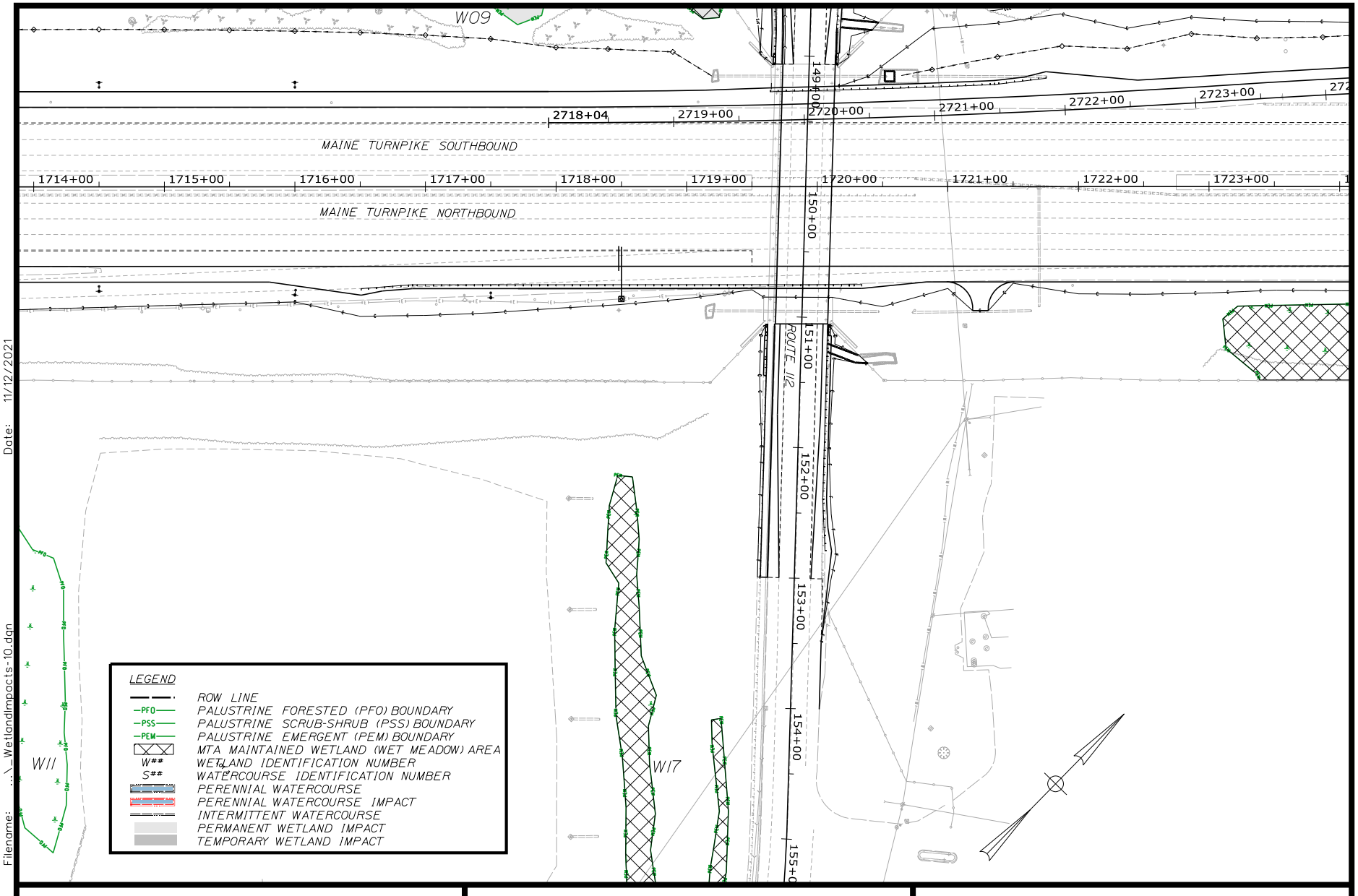
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 9

DATE: NOVEMBER, 2021



Filename: ..._WetlandImpacts-10.dgn Date: 11/12/2021

50 0 50 100
Scale of Feet

Stantec

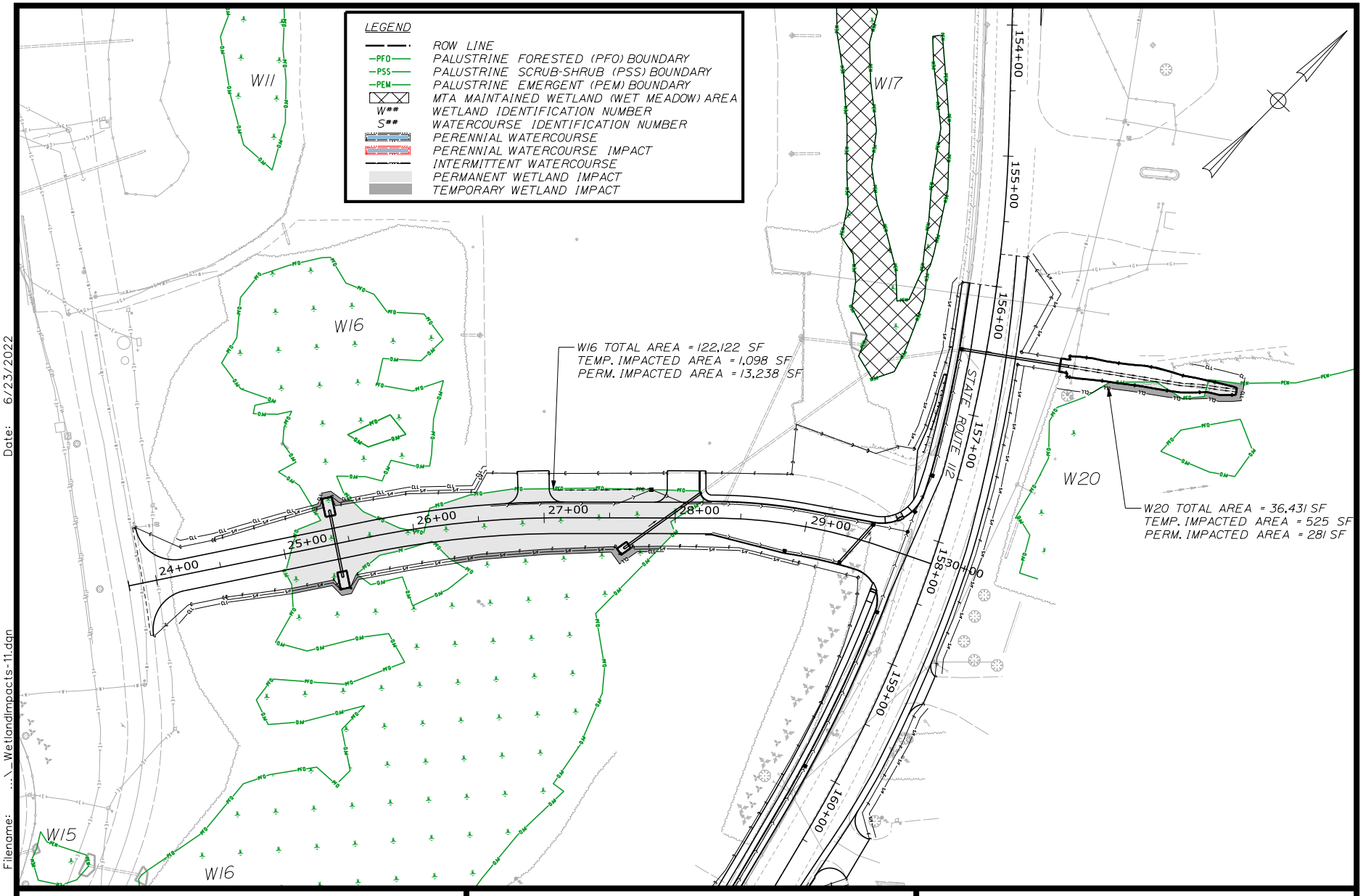
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 10

DATE: NOVEMBER, 2021



Filename: ..._WetlandImpacts-11.dgn Date: 6/23/2022

50 0 50 100
Scale of Feet

Stantec

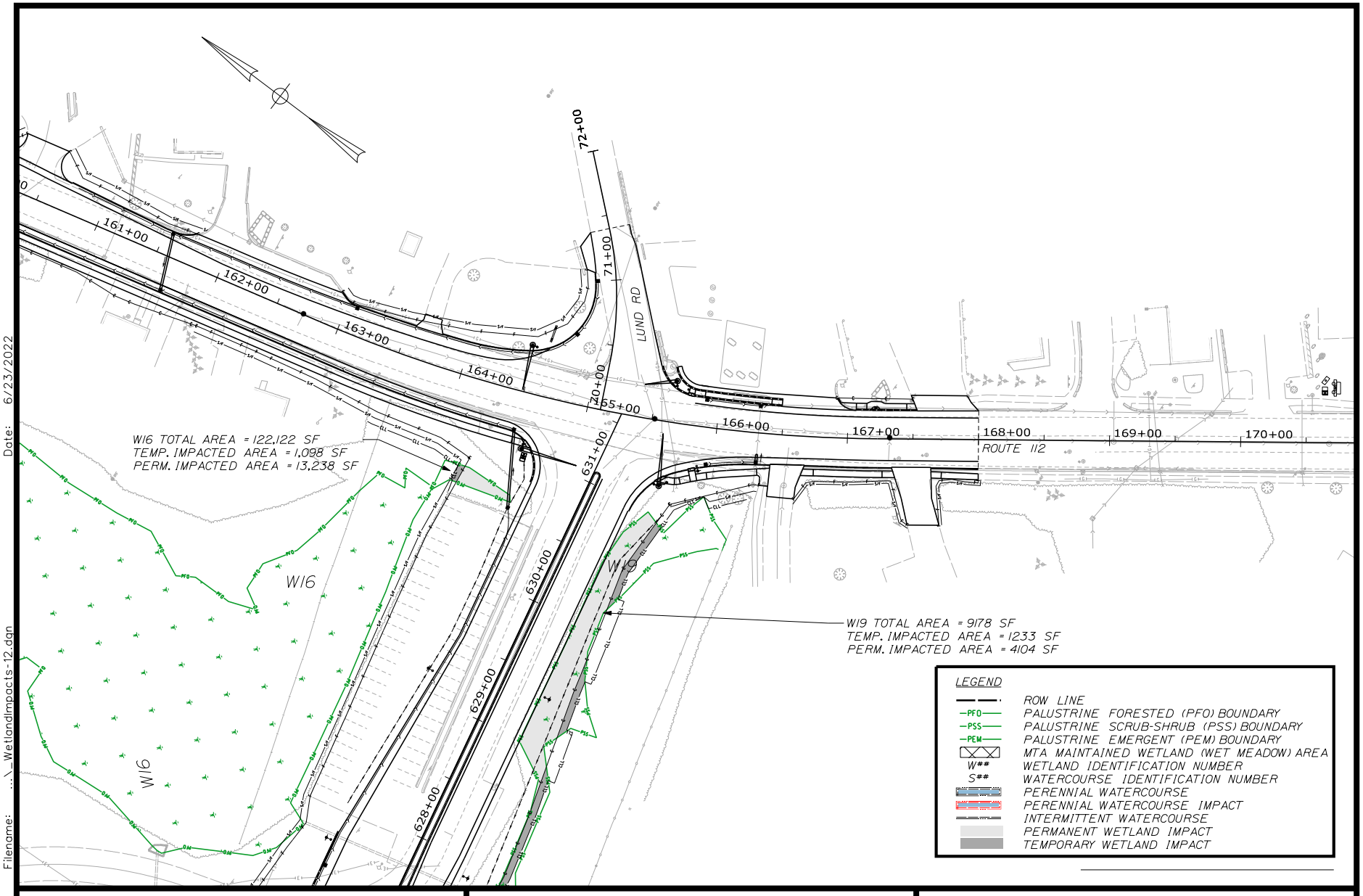
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 11

DATE: JUNE, 2022



Filename: ..._WetlandImpacts-12.dgn Date: 6/23/2022

50 0 50 100
Scale of Feet

Stantec

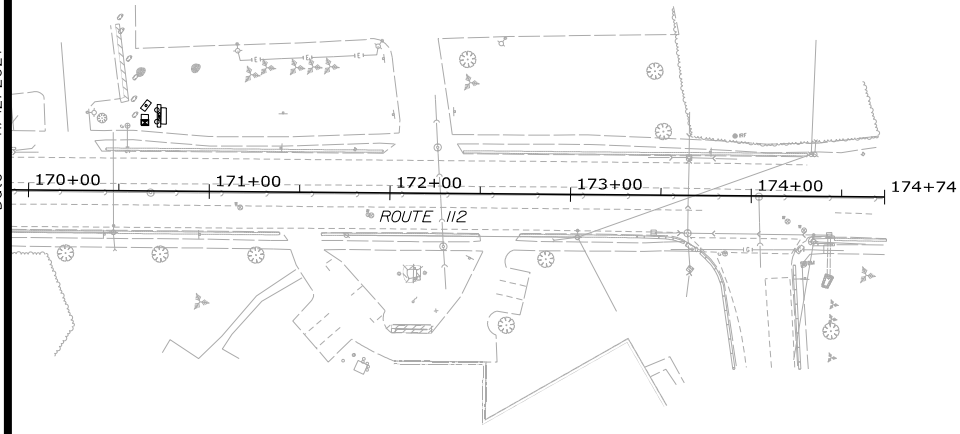
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 12

DATE: NOVEMBER, 2021



LEGEND

	ROW LINE
PFO	PALUSTRINE FORESTED (PFO) BOUNDARY
PSS	PALUSTRINE SCRUB-SHRUB (PSS) BOUNDARY
PEM	PALUSTRINE EMERGENT (PEM) BOUNDARY
	MTA MAINTAINED WETLAND (WET MEADOW) AREA
W##	WETLAND IDENTIFICATION NUMBER
S##	WATERCOURSE IDENTIFICATION NUMBER
	PERENNIAL WATERCOURSE
	PERENNIAL WATERCOURSE IMPACT
	INTERMITTENT WATERCOURSE
	PERMANENT WETLAND IMPACT
	TEMPORARY WETLAND IMPACT

50 0 50 100
Scale of Feet

Stantec

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

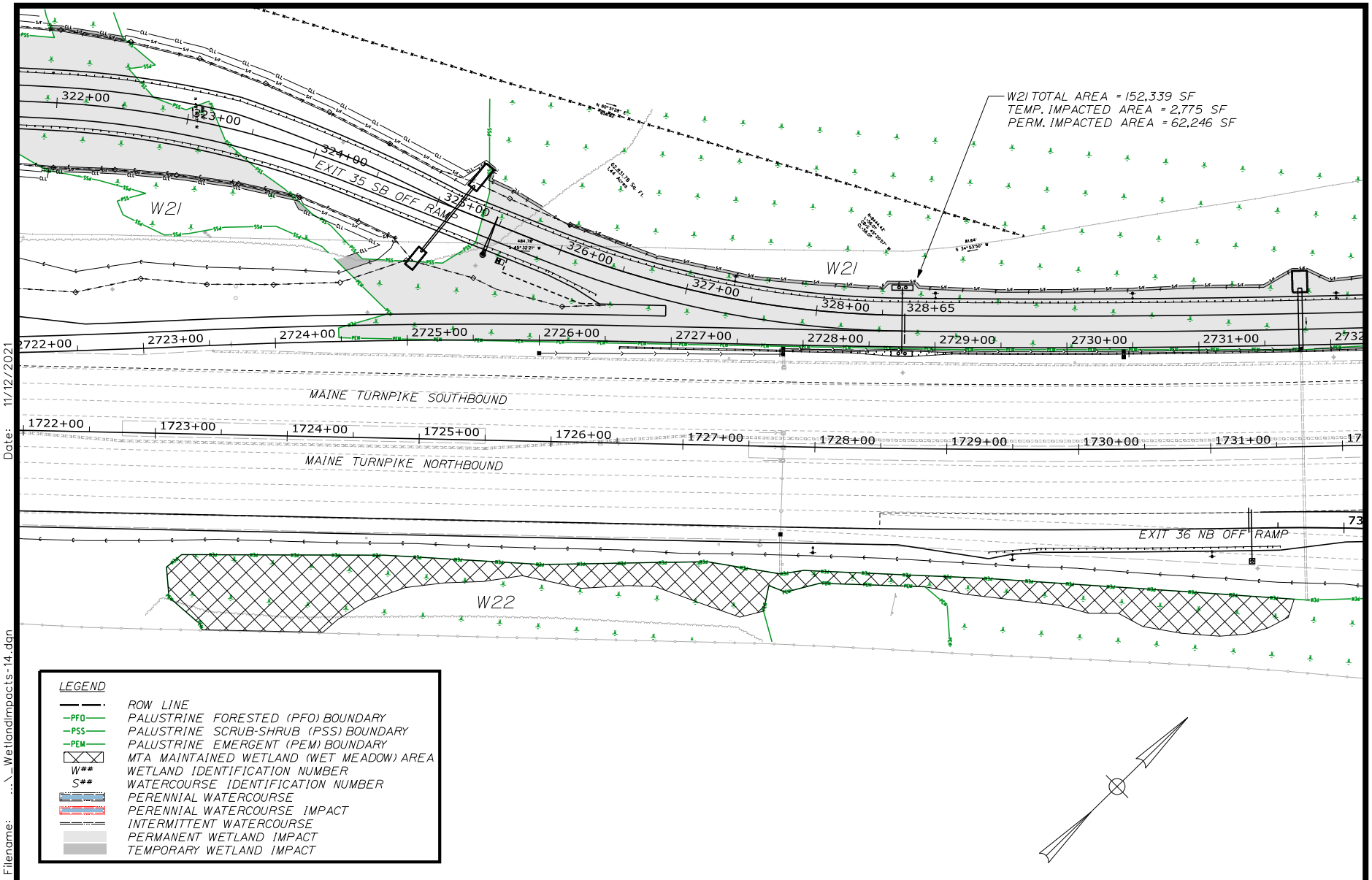
INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP
PLAN VIEW 13

DATE: NOVEMBER, 2021

Date: 11/12/2021

Filename: ..._WetlandImpacts-13.dgn



Date: 11/12/2021

Filename: ..._WetlandImpacts-14.dgn

50 0 50 100
Scale of Feet

Stantec

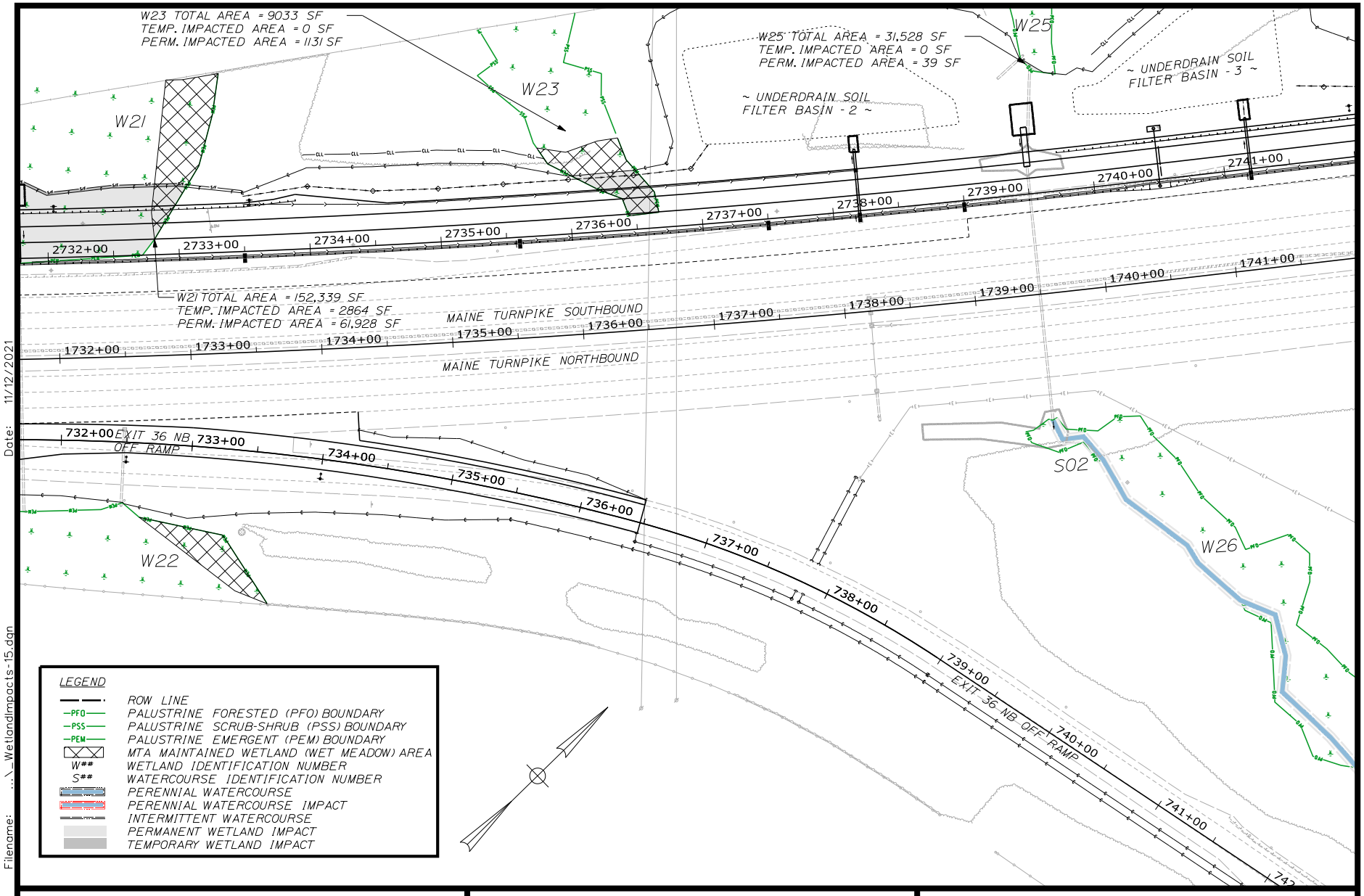
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 14

DATE: NOVEMBER, 2021



Date: 11/12/2021

Filename: ..._WetlandImpacts-15.dgn

50 0 50 100
Scale of Feet

Stantec

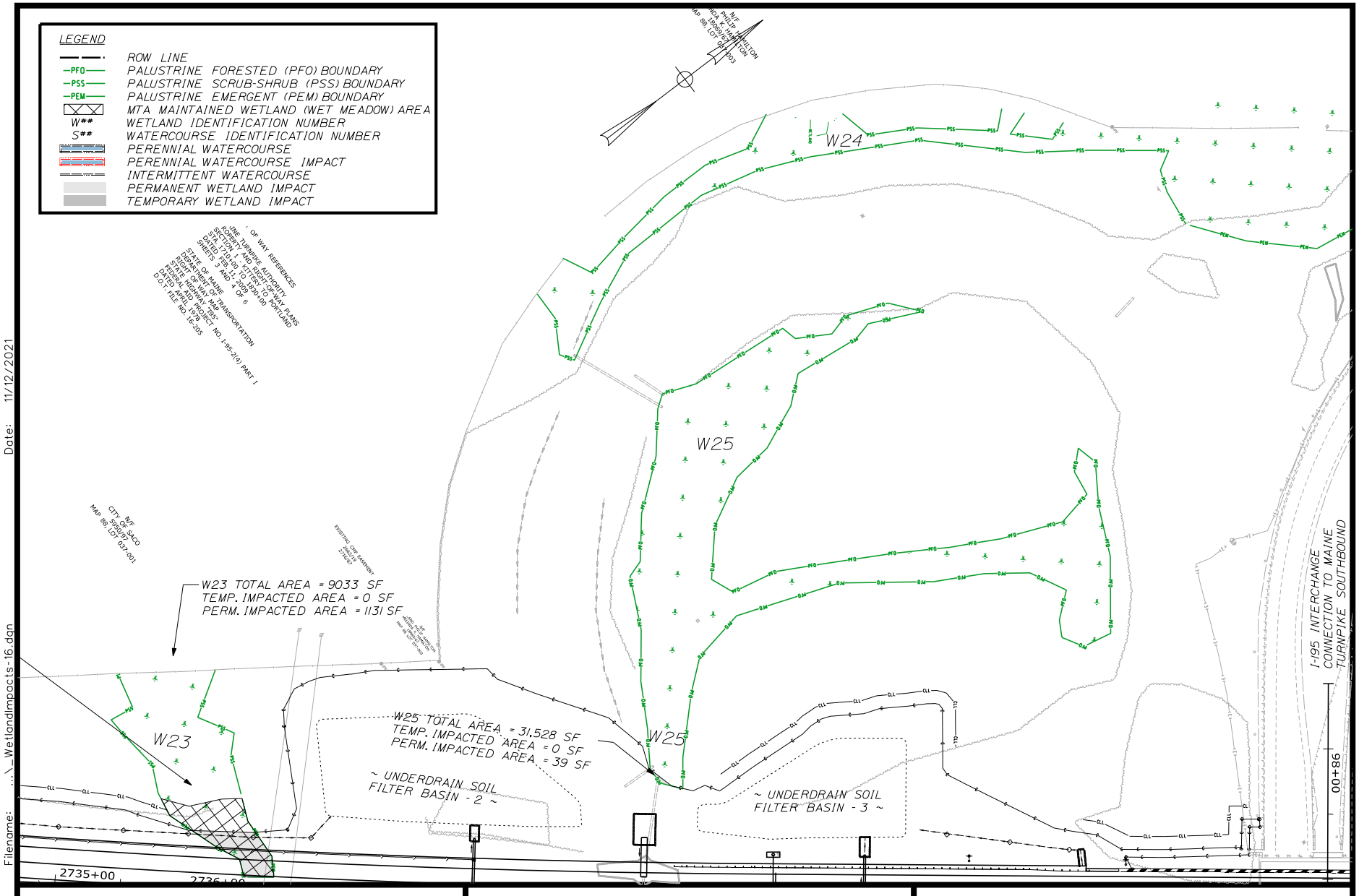
MAINE TURNPIKE

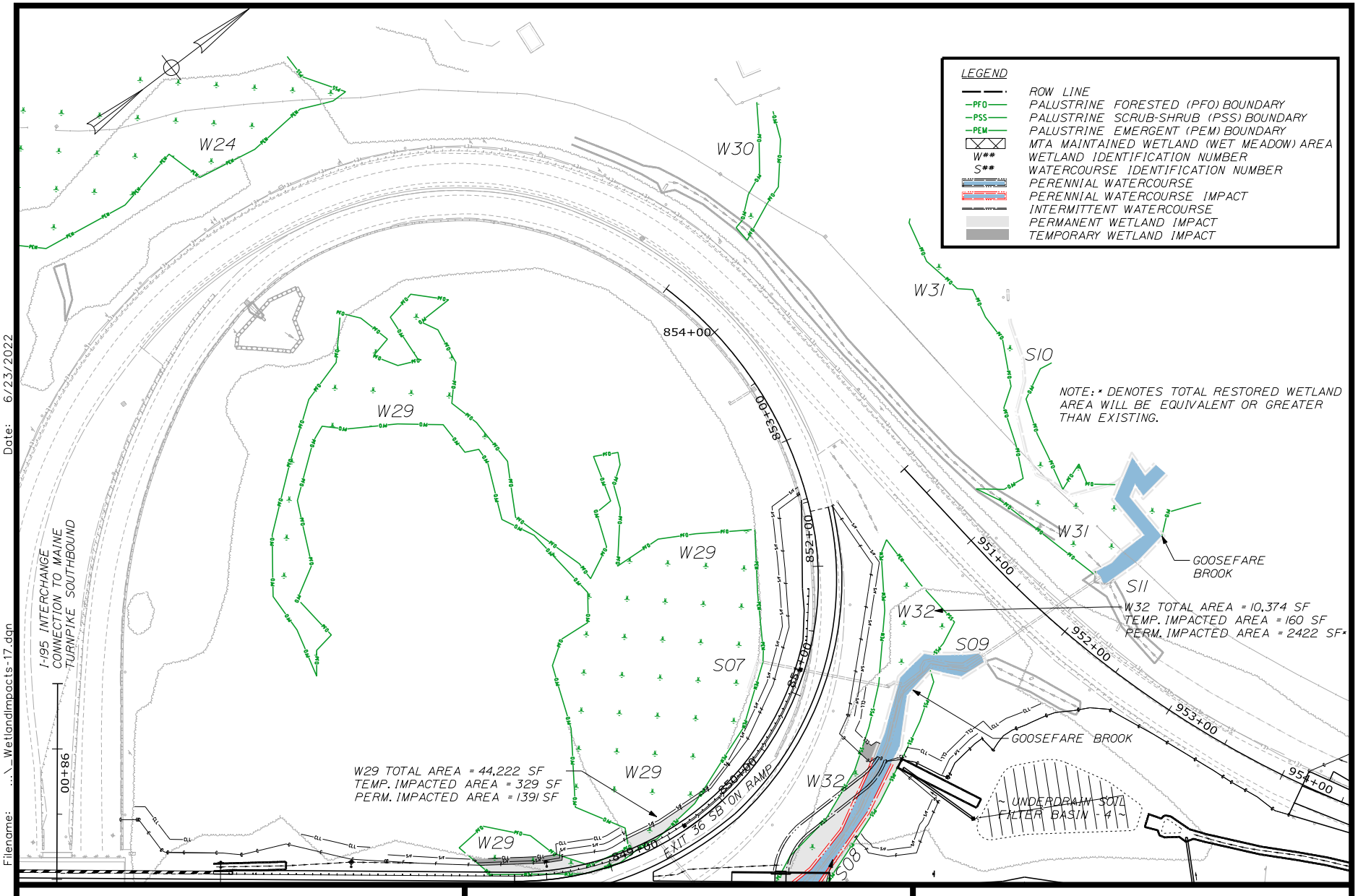
THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 15

DATE: NOVEMBER, 2021


LEGEND
ROW LINE
PALUSTRINE FORESTED (PFO) BOUNDARY
PALUSTRINE SCRUB-SHRUB (PSS) BOUNDARY
PALUSTRINE EMERGENT (PEM) BOUNDARY
MTA MAINTAINED WETLAND (WET MEADOW) AREA
W## WETLAND IDENTIFICATION NUMBER
S## WATERCOURSE IDENTIFICATION NUMBER
PERENNIAL WATERCOURSE
PERENNIAL WATERCOURSE IMPACT
INTERMITTENT WATERCOURSE
PERMANENT WETLAND IMPACT
TEMPORARY WETLAND IMPACT
W24
W25
W23
W23 TOTAL AREA = 9033 SF
TEMP. IMPACTED AREA = 0 SF
PERM. IMPACTED AREA = 1131 SF
W25 TOTAL AREA = 31,528 SF
TEMP. IMPACTED AREA = 0 SF
PERM. IMPACTED AREA = 39 SF
~ UNDERDRAIN SOIL FILTER BASIN - 2 ~
~ UNDERDRAIN SOIL FILTER BASIN - 3 ~
I-195 INTERCHANGE CONNECTION TO MAINE TURNPIKE SOUTHBOUND
2735+00
2736+00
00+86
50 0 50 100
Scale of Feet
Stantec
MAINE TURNPIKE
THE GOLD STAR MEMORIAL HIGHWAY
INTERCHANGE IMPROVEMENTS
SACO (EXITS 35 & 36)
WETLAND & WATERCOURSE DELINEATION MAP
PLAN VIEW 16
DATE: NOVEMBER, 2021
SHEET 17 OF 25
Date: 11/12/2021
Filename: ..._WetlandImpacts-16.dgn



50 0 50 100
Scale of Feet

Stantec

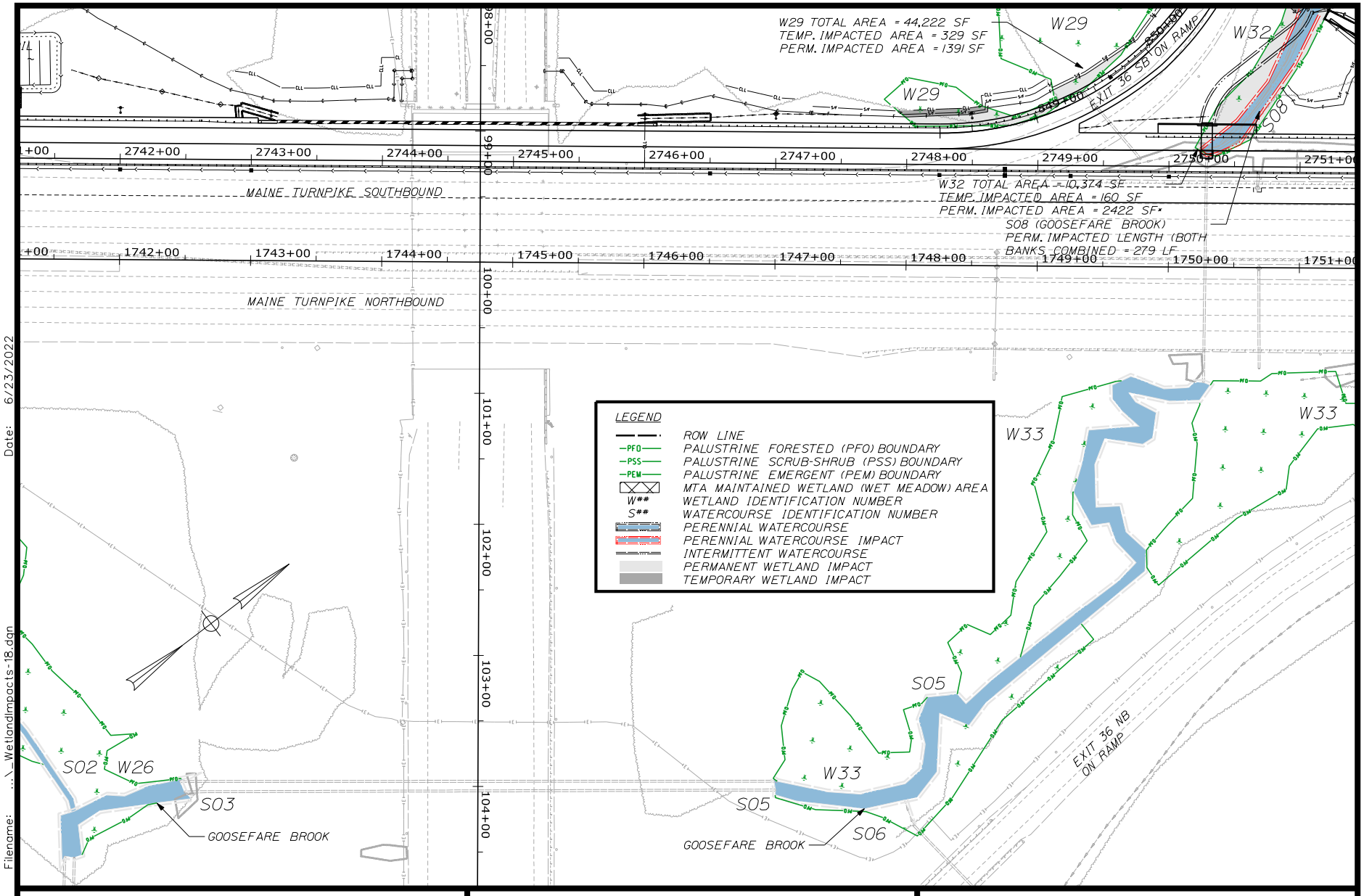
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 17

DATE: JUNE, 2022



Date: 6/23/2022

Filename: ..._WetlandImpacts-18.dgn

50 0 50 100
Scale of Feet

Stantec

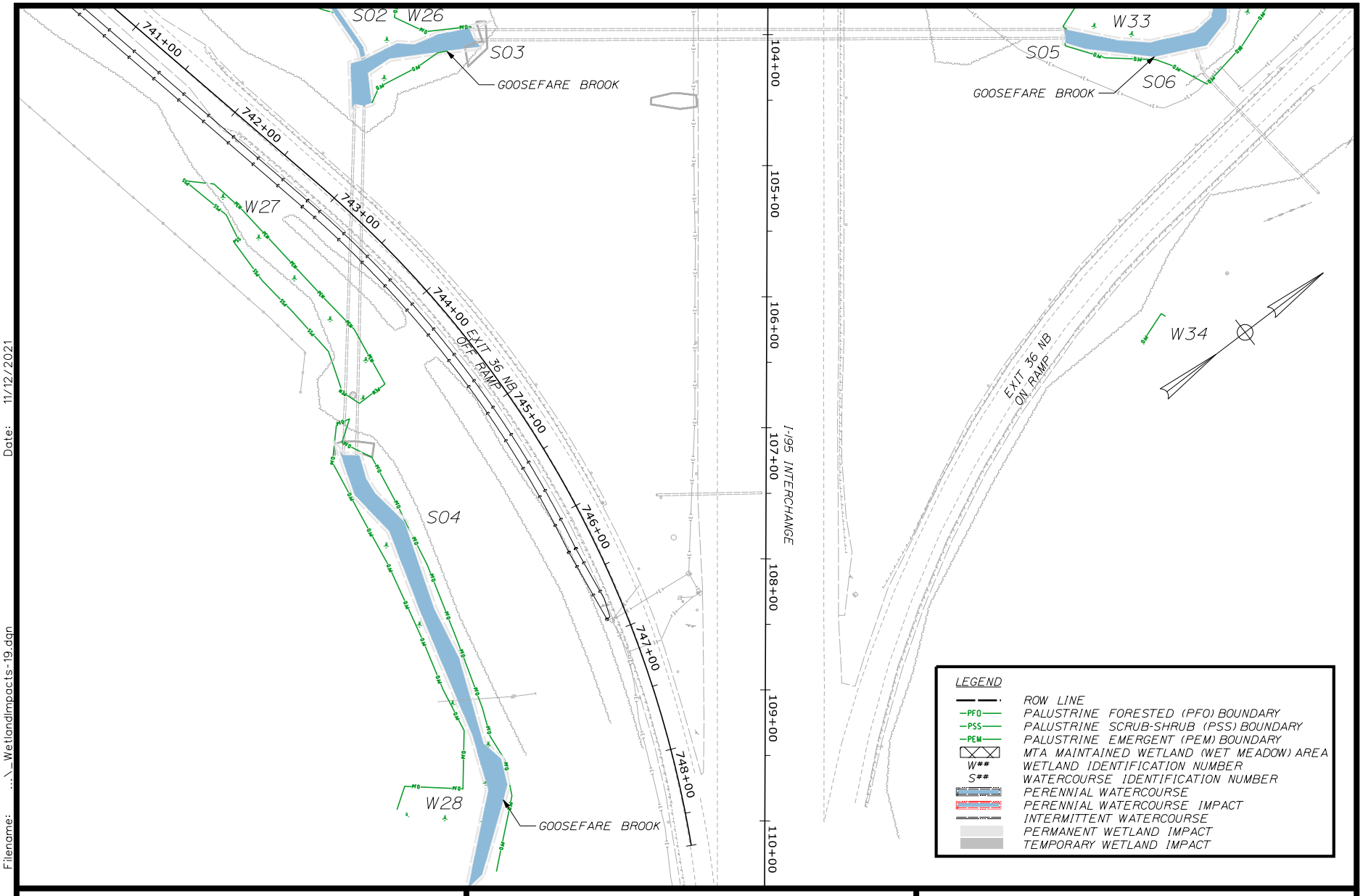
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 18

DATE: JUNE, 2022



Filename: ..._WetlandImpacts-19.dgn Date: 11/12/2021

50 0 50 100
Scale of Feet

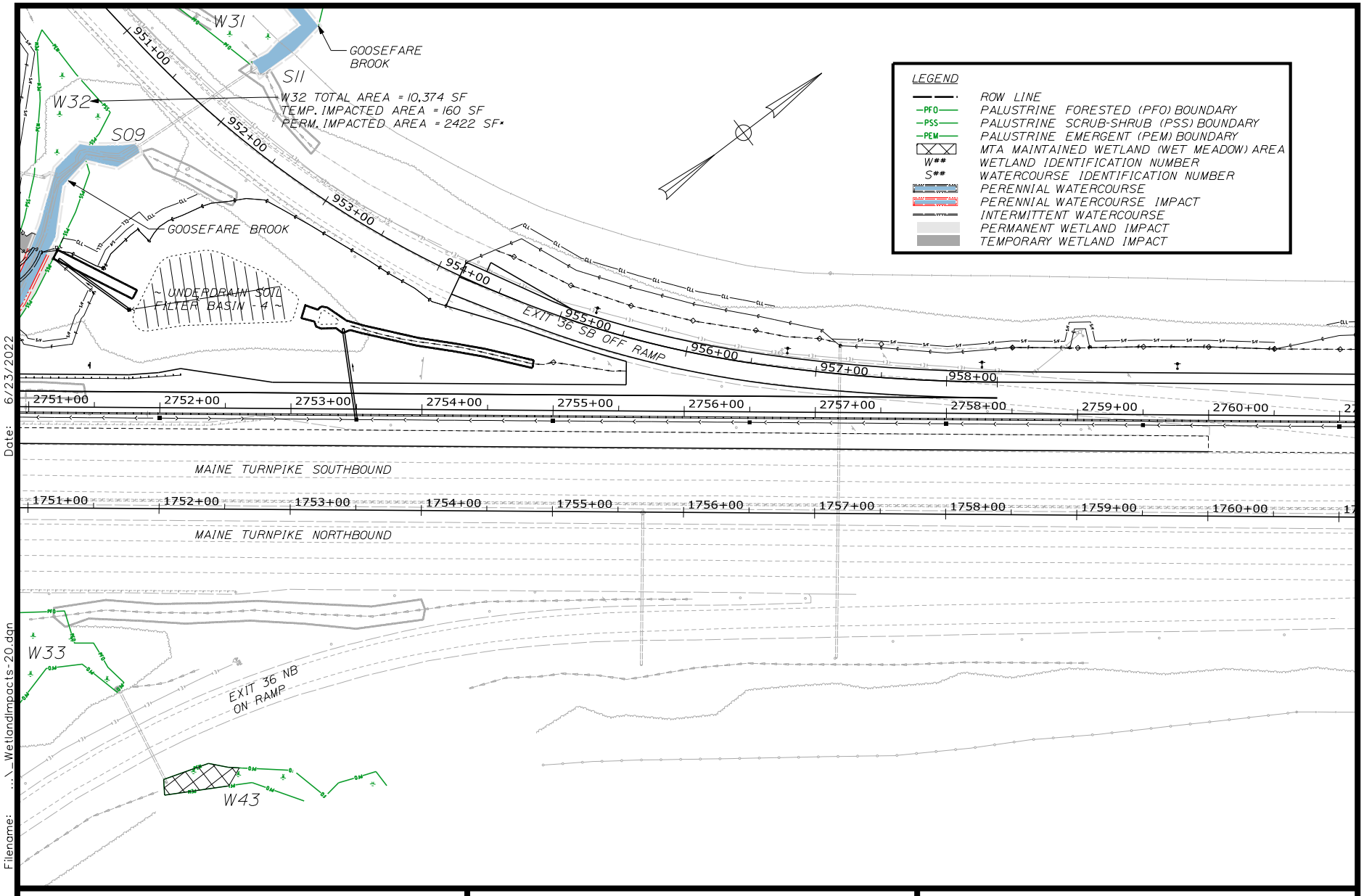
Stantec

MAINE TURNPIKE
THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 19

DATE: NOVEMBER, 2021



Date: 6/23/2022

Filename: ..._WetlandImpacts-20.dgn

50 0 50 100
Scale of Feet

Stantec

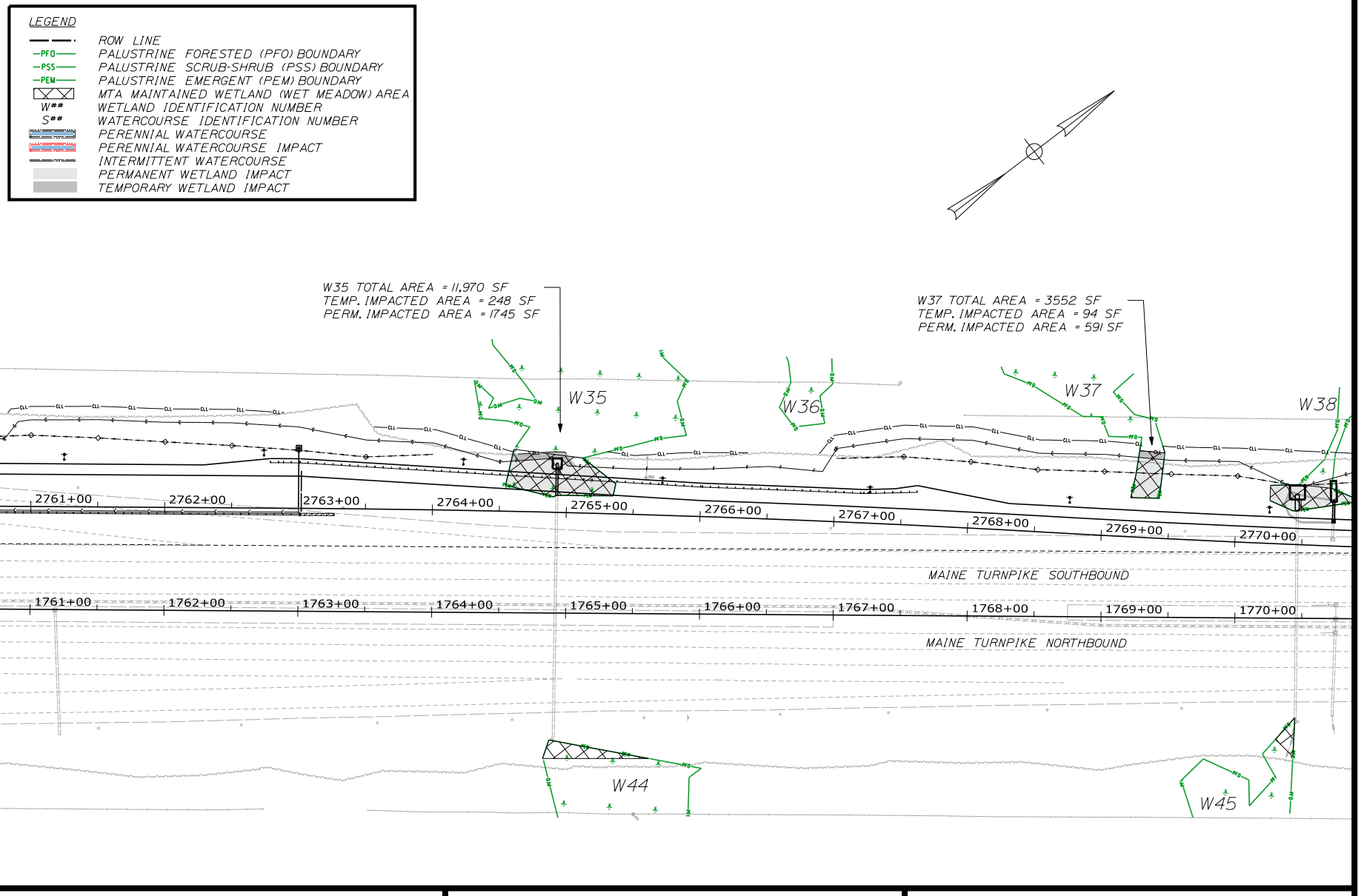
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 20

DATE: JUNE, 2022



Date: 11/12/2021

Filename: ..._WetlandImpacts-21.dgn

50 0 50 100
Scale of Feet

Stantec

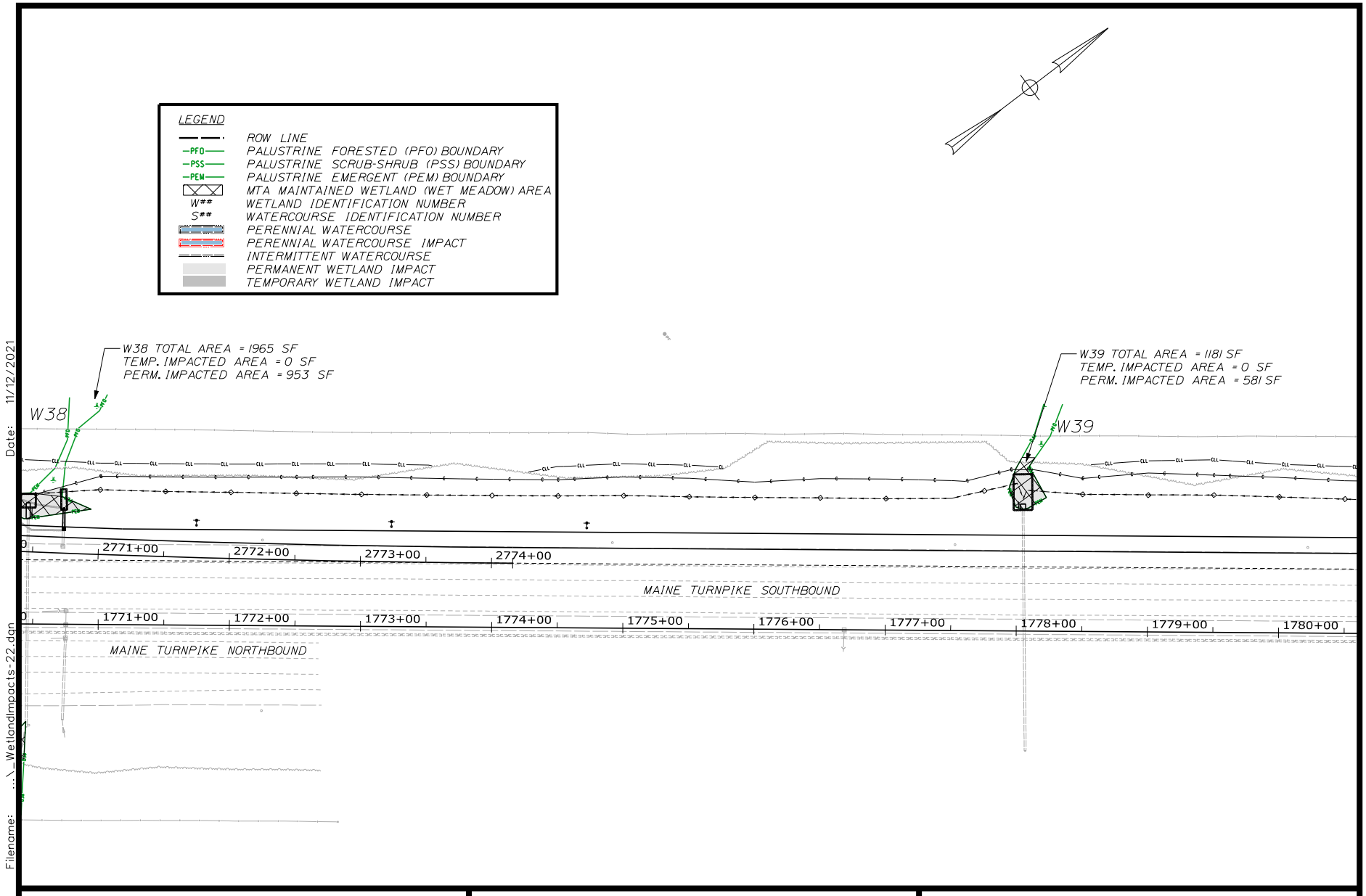
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 21

DATE: NOVEMBER, 2021



Date: 11/12/2021

Filename: ..._WetlandImpacts-22.dgn

50 0 50 100

Scale of Feet

Stantec

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

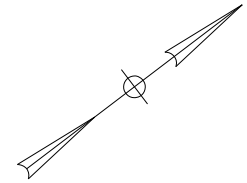
INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

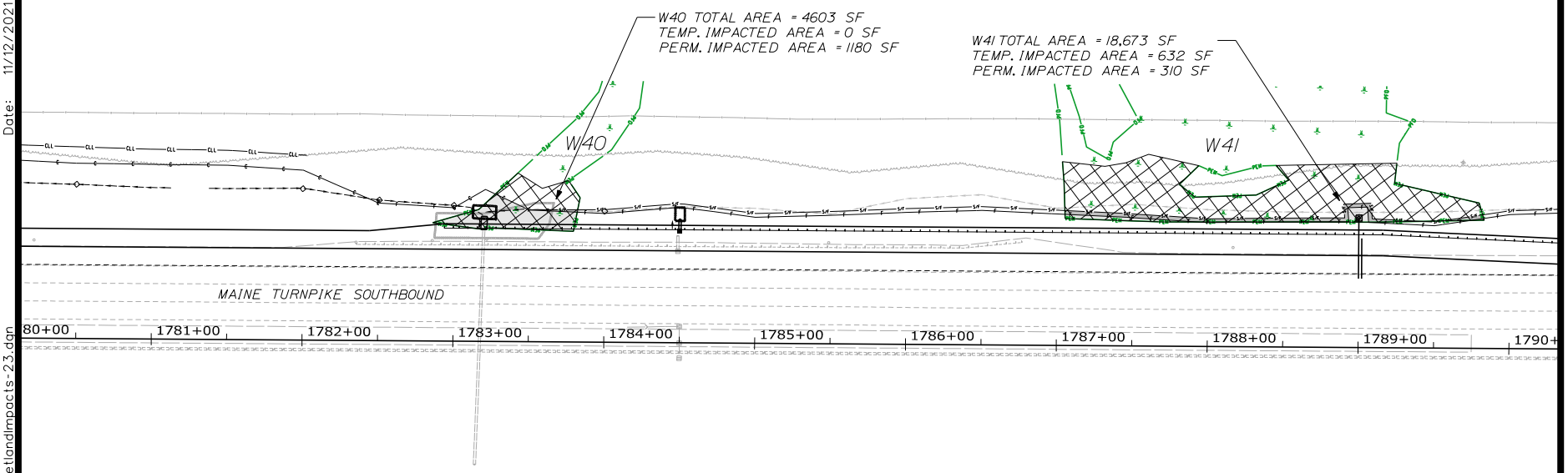
WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 22

DATE: NOVEMBER, 2021

LEGEND

- ROW LINE
- PFO — PALUSTRINE FORESTED (PFO) BOUNDARY
- PSS — PALUSTRINE SCRUB-SHRUB (PSS) BOUNDARY
- PEM — PALUSTRINE EMERGENT (PEM) BOUNDARY
- MTA MAINTAINED WETLAND (WET MEADOW) AREA
- W## WETLAND IDENTIFICATION NUMBER
- S## WATERCOURSE IDENTIFICATION NUMBER
- PERENNIAL WATERCOURSE
- PERENNIAL WATERCOURSE IMPACT
- INTERMITTENT WATERCOURSE
- PERMANENT WETLAND IMPACT
- TEMPORARY WETLAND IMPACT





Date: 11/12/2021

Filename: ..._WetlandImpacts-23.dgn

50 0 50 100
Scale of Feet

Stantec

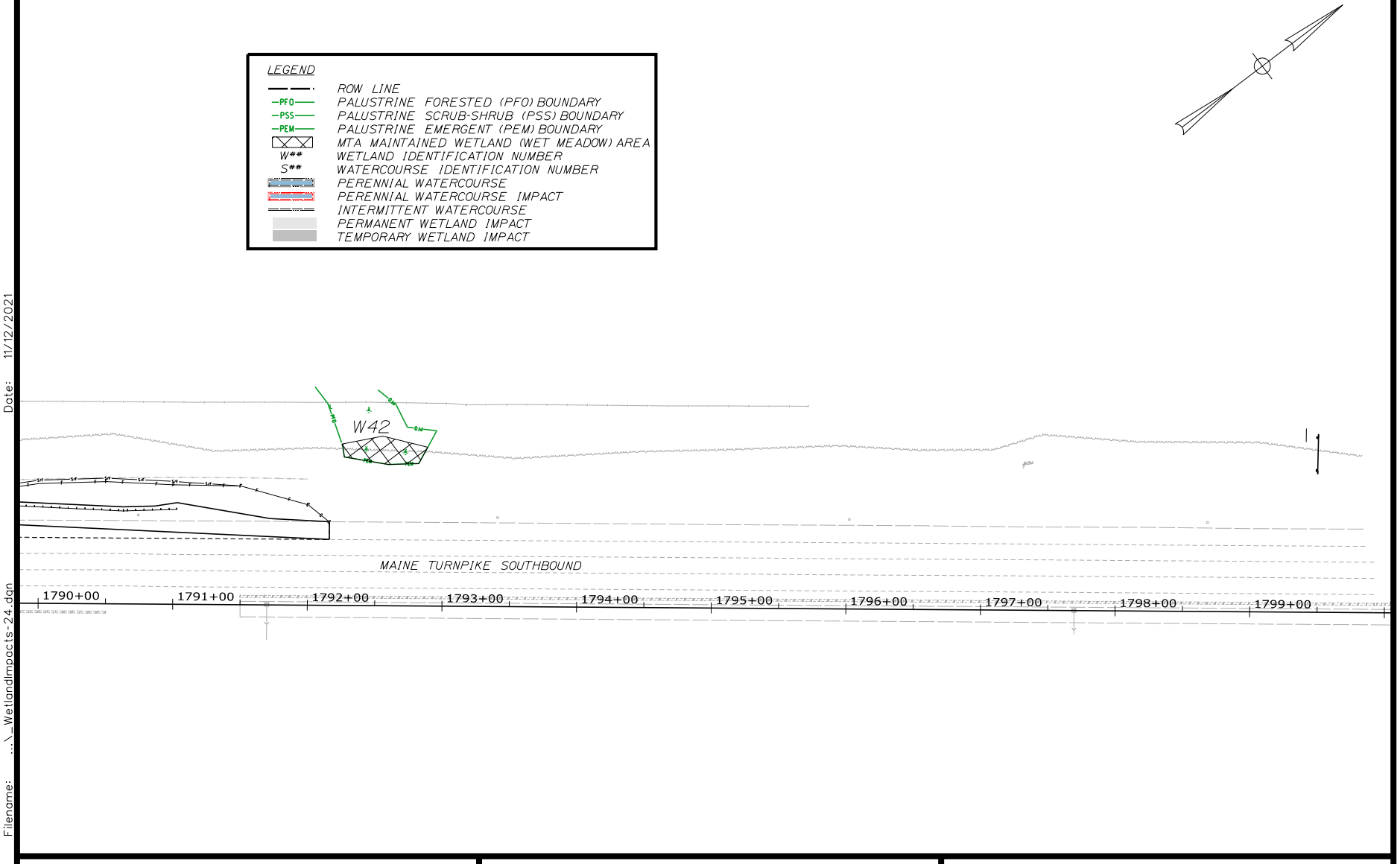
MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 23

DATE: NOVEMBER, 2021



Date: 11/12/2021

Filename: ..._WetlandImpacts-24.dgn

50 0 50 100

Scale of Feet

Stantec

MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36)

WETLAND & WATERCOURSE DELINEATION MAP PLAN VIEW 24

DATE: NOVEMBER, 2021

PROGRESS
6/10/2022

Date:6/22/2022

EXIT 36 SB ON RAMP

LIMIT OF FLOODPLAIN AND WETLAND PLANTINGS

APPROXIMATE LOW-FLOW CHANNEL

PC = STA. 3+74.47

PT = STA. 3+99.11

N29°07'24.94"W

STA. 3+99.11 MATCH EXISTING STREAM BED AND BANKS

PI = STA. 4+11.20

N39°07'08.02"W

PI = STA. 4+41.70

N27°06'07.5

UNDERDRAINED SOIL FILTER BASIN - 3

CURVE DATA #2
PI = 3+87.05
D =114°35'29.6"
Δ = 28°13'38.4" Lt.
R = 50.00'
L = 24.63'
T = 12.57'
E = 1.56'

CURVE DATA #1
PI = 2+98.78
D =114°35'29.6"
Δ = 51°02'26.9" Rt.
R = 50.00'
L = 44.54'
T = 23.87'
E = 5.41'

℄ GOOSEFARE BROOK CULVERT

GOOSEFARE BROOK

N0°53'46.33"W

PRC = STA. 3+19.45

LIMIT OF FLOODPLAIN AND WETLAND PLANTINGS

B-III

B-211

STA. 2+80.40
INVERT EL. = 91.00

PC = STA. 2+74.91

PCMG WALL

CIP CONCRETE HEADWALL

24'-0" EXTENSION

22'-0"

9'-3" ±

10'-6"

PROPOSED 84" RCP CLASS IV CULVERT EXTENSION

PROPOSED CONCRETE COLLAR

EXISTING 84" RCP CULVERT

STA 2750+28.57 SB C-D ROADWAY ℄ =
STA 2+47.15 GOOSEFARE BROOK ℄

SB C-D ROADWAY ℄

EDGE OF PAVEMENT (TYP.)

N37°40'30.31"E

849+00
850+00
2749+00
2750+00
2751+00
2752+00

PLAN VIEW - GOOSEFARE BROOK CULVERT
SCALE: 1" = 10'-0"

Filename: ...\MSTA_Goosefare_Brook_01.dgn

Scale:	Designed by:							
AS NOTED	Stantec							
No.	Revision	By	Date	CONSULTANT PROJECT MANAGER: LAUREN MEEK, P.E.				
					By	Date	By	Date
				Designed	SJW	06\22	Checked	TWM 06\22
				Drawn	SJW	06\22	In Charge of	LEM 06\22

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PORTLAND, ME 04102
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MAINE TURNPIKE

THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: RYAN BARNES, PE, CPESC

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36) GOOSEFARE BROOK CULVERT EXTENSION GENERAL PLAN

SHEET NUMBER: GB-02

CONTRACT:2022.07

Date:6/10/2022

NOTES

1. PRIOR TO INSTALLING THE SPECIAL FILL - STREAMBED MATERIAL, THE VOID-FILLED RIPRAP TYPE "A" SHALL BE FLOODED AND OBSERVED TO ENSURE THAT THE TOP LAYER OF THE VOID-FILLED RIPRAP TYPE "A" WILL POND WATER ON THE SURFACE. ADDITIONAL MATERIAL WITH SIGNIFICANT PROPORTION OF FINES SHALL BE WASHED-IN TO FILL AND SEAL ANY REMAINING VOIDS UNTIL WATER PONDS ON THE SURFACE.
2. LOW-FLOW CHANNEL VARIES HORIZONTALLY FROM 0' TO 1' TO EITHER SIDE OF CHANNEL CENTERLINE. SEE PLAN FOR APPROXIMATE ALIGNMENT OF THE LOW-FLOW CHANNEL.
3. THE LOCATIONS OF PROPOSED STREAM BUFFER PLANTINGS ARE NOT SHOWN ON THE PLANS. APPROXIMATE PLANTING AREAS ARE PROVIDED. THE PLANTING CONTRACTOR SHALL COORDINATE THE PLANTING WORK WITH THE RESIDENT ENGINEER AND MAINE TURNPIKE AUTHORITY WETLAND SCIENTIST OR DESIGNEE.
4. PLANTS SHALL BE NATIVE TO THIS REGION AND SHALL BE DERIVED FROM PLANT STOCK NATIVE TO NEW ENGLAND AND THE NORTHEAST, AND SHALL BE THE SPECIES AND SIZES SPECIFIED. THE INDICATED SPECIES, SIZES, PLANT NUMBERS FOR PLANTING IN THE STREAM BUFFER ARE LISTED IN SPECIAL PROVISION 621 AND THESE PLANS. PLANT SPECIES HAVE BEEN SPECIFICALLY CHOSEN FOR THEIR SALT-TOLERANCE. SUBSTITUTIONS MAY BE MADE ONLY WITH PRIOR REQUEST AND WRITTEN APPROVAL FROM THE MAINE TURNPIKE AUTHORITY WETLAND SCIENTIST OR DESIGNEE.
5. THE CONTRACTOR SHALL FOLLOW THE MAINE DEPARTMENT OF TRANSPORTATION (MAINEDOT) 2014 STANDARD SPECIFICATIONS FOR LANDSCAPE MATERIALS AND INSTALLATION PROCEDURES (SECTION 621) EXCEPT AS PROVIDED IN SPECIAL PROVISION 621 AND THESE PLANS.
6. INSTALLATION OF THE SPECIFIED PLANTS SHALL BE PERFORMED ONLY DURING PERIODS WHEN BENEFICIAL RESULTS CAN BE OBTAINED. BASED ON SEASONAL AND CLIMACTIC FACTORS AND LOCAL WEATHER CONDITIONS. FOR THE SPECIFIED PLANTINGS, SPRING AND SUMMER PLANTING TIMES ARE PREFERRED OVER FALL PLANTING TO ALLOW TIME FOR THE PLANTS' ROOT SYSTEM TO BECOME WELL ESTABLISHED PRIOR TO WINTER. THIS SPECIFICATION IS INTENDED TO HELP PLANTS WITHSTAND THE EXPECTED STRESS AND DAMAGE ASSOCIATED WITH WINTER ROAD SALT APPLICATIONS IN THIS LOCATION.
7. PLANTINGS SHALL BE INSTALLED ON SLOPES, SHALLOW BERMS, OR MOUNDS TO SHED RUNOFF AND HELP MINIMIZE THE ACCUMULATION OF SALT AT THE BASE OF THE PLANTS. PLANTS SHALL NOT BE INSTALLED IN DEPRESSIONS AND SHALL BE WELL MULCHED TO PROTECT THE BASE OF THE PLANT AND PREVENT WATER LOSS. PLANTS SHALL BE INSTALLED A MINIMUM OF 35 FEET FROM ROADWAY EDGE.
8. SEE THE LANDSCAPING PLANS FOR PLANTING LOCATIONS.

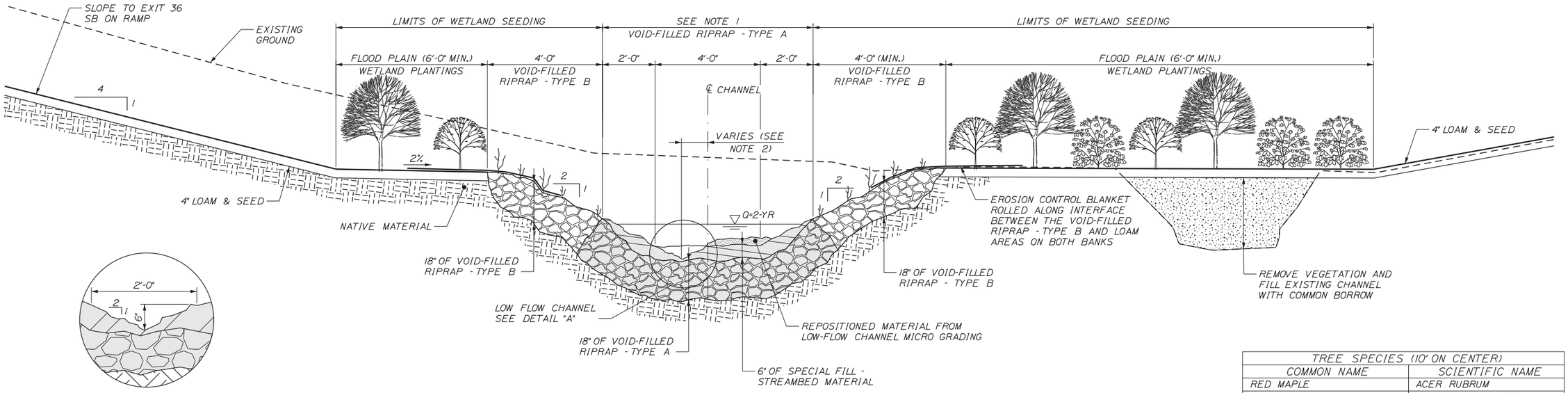
SEEDING NOTES:

TEMPORARY SEEDING AND MULCHING

1. PAYMENT FOR TEMPORARY SEEDING SHALL BE PAID FOR UNDER ITEM 618.15 AND TEMPORARY MULCH SHALL BE PAID FOR UNDER ITEM 619.1202.
2. ANY EXPOSED AREAS WHERE ACTIVITY IS NOT ANTICIPATED FOR MORE THAN 7 DAYS SHALL BE TEMPORARILY SEEDED AND/OR MULCHED OR OTHERWISE STABILIZED. AREAS WITHIN 75 FT OF A WETLAND OR WATERBODY SHALL BE STABILIZED WITHIN 48 HOURS OF THE INITAIL DISTURBANCE OF THE SOIL OR PRIOR TO ANY STORM EVENT, WHICHEVER COMES FIRST.
3. EXPOSED OR BARE SOIL SHALL BE MULCHED AT THE COMPLETION OF WORK, EACH DAY, IF SIGNIFICANT RAINFALL IS PREDICTED OR IMMINENT.
4. TEMPORARYY MULCH APPLIED DURING THE WINTER MONTHS OF NOVEMBER 1 THROUGH APRIL 15 SHALL BE APPLIED AT TWICE THE STANDARD TEMPORARY STABILIZATION RATE OR 150 LBS. PER 1,000 SQUARE FEET.
5. ANY TEMPORARY SEEDING SHALL CONSIST ANNUAL RYE GRASS (SEEDING DATES APRIL 1 TO JULY 1) AT 0.9 LBS PER 1,000 SQUARE FEET OR WINTER RYE GRASS (SEEDING DATES AUGUST 15 TO OCTOBER 1) AT 2.6 LBS PER 1,000 SQUARE FEET.

PERMANENT SEEDING

1. DURING PERIODS FROM APRIL 15 TO SEPTEMBER 15, PERMANENT SEEDING SHALL BE COMPLETED IMMEDIATELY (WITHIN 7 DAYS) FOLLOWING FINAL GRADING. AREAS SHALL BE MULCHED IMMEDIATELY AFTER SEEDING AT A RATE OF 75 LBS. PER 1,000 SQUARE FEET. PERMANENT SEED MIX SHALL BE APPLIED PER THE SUPPLIER'S SPECIFICATIONS.



DETAIL "A" - LOW FLOW CHANNEL
SCALE: 1" = 1'-0"

TYPICAL SECTION GOOSEFARE BROOK CHANNEL
(LOOKING UPSTREAM)
SCALE: 1/2" = 1'-0"

TREE SPECIES (10' ON CENTER)	
COMMON NAME	SCIENTIFIC NAME
RED MAPLE	ACER RUBRUM
GREEN ASH	FRAXINUS PENNSYLVANICA
GRAY BIRCH	BETULA POPULIFOLIA
BLACK WILLOW	SALIX NIGRA
SHRUB SPECIES (5' ON CENTER)	
NANNYBERRY	VIBURNUM LENTAGO
WINTERBERRY	ILEX VERTICILLATA
SERVICEBERRY	AMELANCHIER CANADENSIS
SEED MIX	
NEW ENGLAND WETMIX (WETLAND SEED MIX) OR EQUIV.	

PROGRESS
6/10/2022

Filename: ...\MSTA_Goosefare_Brook_02.dgn

Scale: AS NOTED

No.	Revision	By	Date

Designed by: Stantec

CONSULTANT PROJECT MANAGER: LAUREN MEEK, P.E.

	By	Date		By	Date
Designed	SJW	06\22	Checked	TWM	06\22
Drawn	SJW	06\22	In Charge of	LEM	06\22

STANTEC CONSULTING SERVICES INC.
2211 CONGRESS STREET SUITE 380
PORTLAND, ME 04102
TEL (207) 887-3448
FAX (207) 883-3376

MAINE TURNPIKE

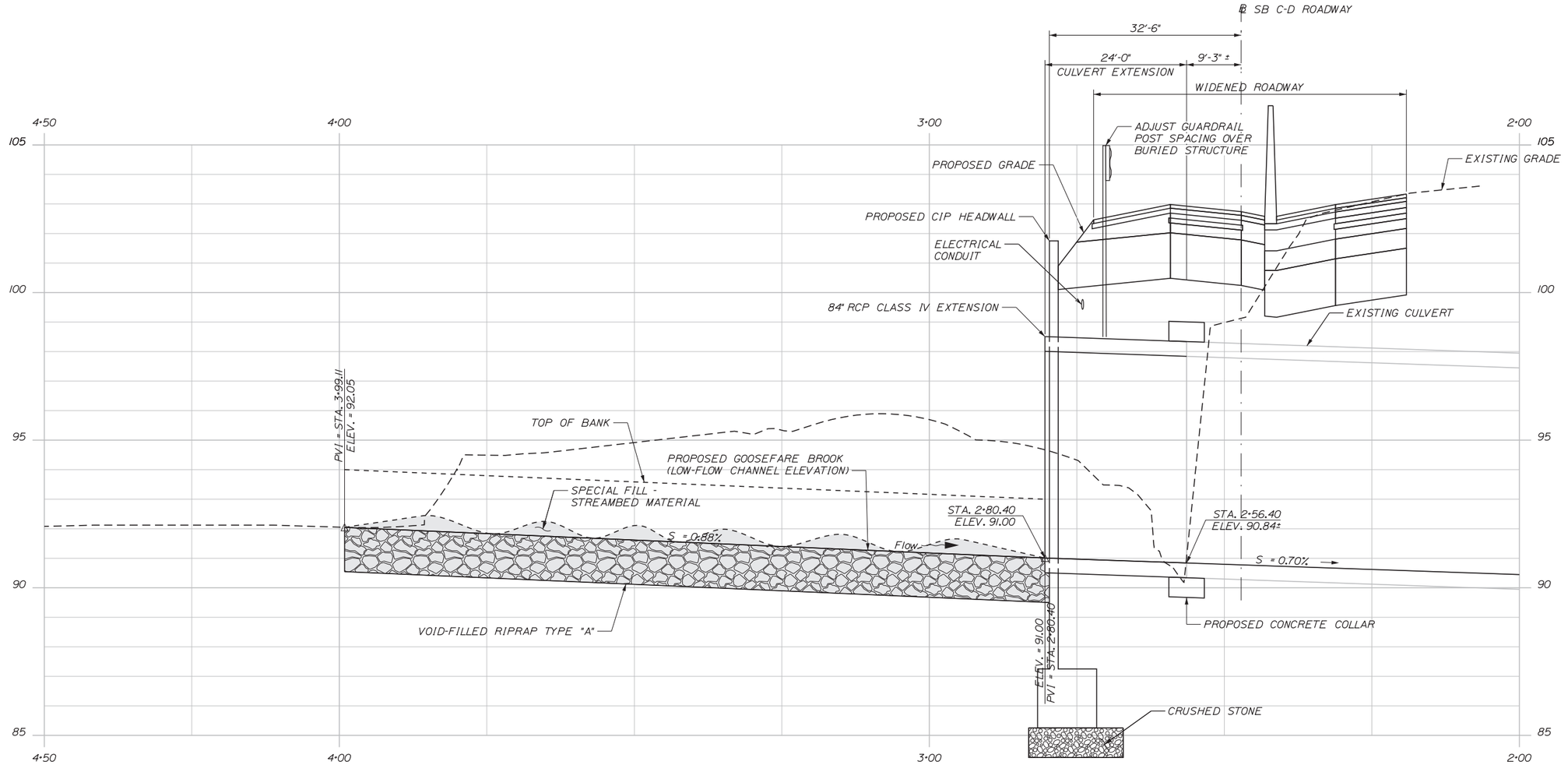
THE GOLD STAR MEMORIAL HIGHWAY

MTA PROJECT MANAGER: RYAN BARNES, PE, CPES

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36) GOOSEFARE BROOK CULVERT EXTENSION DETAILS

SHEET NUMBER: GB-03

CONTRACT:2022.07



GOOSEFARE BROOK PROFILE

Horiz. 10 0 10 20

Vert. 5 0 5 10

Scale of Feet

PROGRESS
6/10/2022

Date:6/10/2022

Filename: ...\MSTA_Goosefare_Brook_03.dgn

Scale: AS NOTED			
No.	Revision	By	Date

Designed by: Stantec

CONSULTANT PROJECT MANAGER: LAUREN MEEK, P.E.

	By	Date		By	Date
Designed	SJW	06\22	Checked	TWM	06\22
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MTA PROJECT MANAGER: RYAN BARNES, PE, CPES

INTERCHANGE IMPROVEMENTS SACO (EXITS 35 & 36) GOOSEFARE BROOK CULVERT EXTENSION DETAILS

SHEET NUMBER: GB-04

CONTRACT:2022.07

APPENDIX I

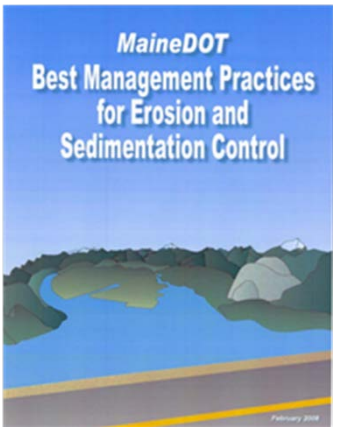
Stormwater Awareness Affidavit

MTA Contractor Stormwater Awareness Affidavit

Contract Name:		**Contract #:**	
Contractor Name:			

PROJECT INFORMATION

MS4 Urbanized Area:	☐ **Yes** _____ *Community Name(s)* ☐ **No**
Urban Impaired Stream (UIS) Watershed:	☐ **Yes**_____ *UIS Name(s)* ☐ **No**



Stormwater runoff is among the most significant pollution sources impacting Maine waters, and is regulated on MTA construction sites under state and federal regulations. For these reasons, it is essential that MTA's stormwater infrastructure is constructed, operated, and maintained to reduce and minimize stormwater pollution. Contractors are required to implement appropriate stormwater best management practices (BMPs) to further minimize stormwater pollutants associated with their work for the MTA. Maine relies on clean water for drinking, fishing, swimming, and many other important uses. Polluted stormwater runoff impacts everyone in Maine, and must be controlled by the Contractor at MTA construction sites as a matter of compliance with MTA's permits and state and federal regulations.

Contractors must comply with stormwater specifications and pollution prevention measures as required by project-specific permits, and as detailed in **MTA's Supplemental Specification – Section 656 – Temporary Soil Erosion and Water Pollution Control**, as generally summarized below:

Designate and document an On-Site Responsible Party (OSRP) responsible for erosion and sediment control at the site that is certified by DEP's NPS Training Program to be knowledgeable of stormwater pollution prevention measures, specifically erosion prevention, sedimentation control and other potential impacts to water quality in Maine.

Install, inspect, and maintain all temporary erosion and sedimentation control materials in accordance with the manufacturer's recommendations. Refer to the Maine Erosion and Sediment Control Practices Field Guide for Contractors for detailed information on installing and maintaining erosion and sediment control measures.

Implement and maintain stormwater best management practices (BMPs) to minimize the mobilization and discharge of pollutants in stormwater to waterbodies by controlling construction site runoff. Implementing appropriate BMPs, as described in MaineDOT's BMPs Manual, to all MTA related construction activities will help to minimize stormwater pollutants introduced to Maine's waterbodies.

Develop and provide to the Resident Engineer a Spill Prevention Control and Countermeasure (SPCC) Plan for any areas where petroleum products, oils or non-petroleum hazardous materials are handled or stored.

Control spills and properly cleanup, report, containerize, and dispose of petroleum and/or other hazardous material waste that results from the actions and/or equipment of the Contractor or his employees, subcontractors, and suppliers.

SIGNATURE

By signing below, you acknowledge that you have read, understand, and will disseminate this information to individuals working on this project.

Name _____ Title _____

Signature _____ Date _____

APPENDIX J

Plaza Safety Requirements

PLAZA SAFETY REQUIREMENTS
INTERCHANGE IMPROVEMENTS
SACO (EXISTS 35 & 36)
(MM 34.7 TO MM 36.6)

The following are the minimum Plaza Lane closure requirements for completing the work. The limits have been set to protect Turnpike patrons and Toll Attendants from potential harm during the construction. The Contractor shall utilize this information in bidding the work. Drums and constructions signs will be paid under their respective pay items. Movement of drums and construction signs will be paid under the Maintenance of Traffic pay item.

The Contractor shall furnish, erect, maintain and relocate twenty 10 inch by 14 inch (minimum dimensions) DANGER – Unauthorized Persons Keep Out, or DANGER – DO NOT ENTER signs, meeting OSHA specifications for size, color and legend, for installation on toll booths or drums, as directed by the Resident. The Contractor shall furnish and install red hazard safety tape between barrels and in cordoned off tunnel and lane areas to identify the hazard areas for Turnpike patrons and Toll Attendants. The purchase, erection, maintenance, and relocation of the hazard signs and hazard safety tape shall be incidental to the mobilization pay item. Providing, maintaining and relocating the specified plywood safety walkways at all locations shall also be incidental to the mobilization pay item.

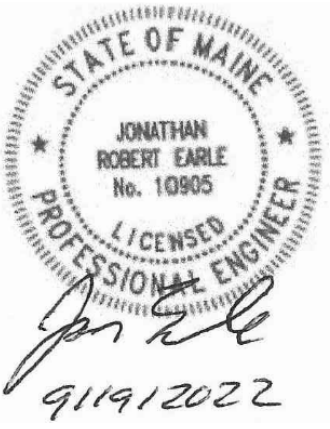
Unless otherwise specified all labor, materials and equipment required to meet the requirements of Appendix J shall be incidental to the various pay items. Maintenance of Traffic signing shall be in place during plaza work at all times.

APPENDIX K

Maine Water Specifications

SPECIFICATIONS & AGREEMENT
FOR
TRENCHING, BACKFILLING AND INSTALLING
WATER MAINS AND APPURTENANCES

WATER MAIN REPLACEMENT CROSSING UNDER
MAINE TURNPIKE IN SACO
STATE ROUTE 112 & MAINE TURNPIKE



THE MAINE WATER COMPANY

INDEX TO SPECIFICATIONS

SECTION I.
GENERAL CONDITIONS

DEFINITION OF TERMS

The word "MWC" or "COMPANY" is used to designate The Maine Water Company, whose principal place of business is Saco, Maine, or its duly authorized representatives for whom the work hereinafter described is to be performed.

The word "CONTRACTOR" is used to designate the party or parties contracting or agreeing to perform the work or his or their heirs, executors, administrators, successors or assigns.

The word "Inspector" or "Engineer" refers to the person appointed by MWC to inspect the work and shall extend to and include any assistant whom he may designate.

The word "Work" is used to designate the work, materials and things required to be done, furnished or performed by the CONTRACTOR under the specifications.

Wherever the words "directed", "required", "performed", or words of like import are used, it shall be understood that the direction, requirement or permission of MWC is intended, and similarly the words "approved", "acceptable", "satisfactory" or words of like import shall mean approved by or acceptable or satisfactory to MWC.

WORK TO BE DONE

The work to be done under this contract includes (except as here-in-after otherwise specified) labor, tools, plant and equipment required for receiving, inspecting, hauling, distributing, installing, testing and disinfecting the water pipes and appurtenances including valves, fittings, hydrants, excavation and backfill, removing and replacing pavements, all as shown on the drawings, mentioned in the specifications or ordered by MWC, complete in every detail, ready for operation. The work shall include maintaining the road surface throughout construction as required by the governing agency until such time as permanent paving can be placed. Permanent pavement shall be paid in Section E. Excavation and Restoration.

PROJECT MATERIALS

The CONTRACTOR shall be responsible for providing all earthwork materials required for installation, such as bedding sand, select backfill, gravel, loam, etc. The COMPANY will procure all waterworks materials, which may include but not be limited to, water pipe, fittings, valves, valve boxes, tapping sleeves, joint restraints, fire

hydrants, polyethylene wrap, service line copper and brass, curb boxes, tracer wire, brass wedges, etc. and all other materials required for completion of the project.

MATERIAL MANAGEMENT

The CONTRACTOR will be responsible for all labor associated with receiving, unloading, job site distribution, storage and safe keeping until installation of all materials required for the completion of the project. Excess material should be protected from the elements and be in suitable condition for return to MWC material supplier. The CONTRACTOR will be compensated for performing these tasks in Section D. Site Management.

LOCATION

The work is located primarily in public streets or right of ways in the area shown on the contract drawings.

PERMITS

The COMPANY will be responsible for obtaining and paying for all necessary Maine State Highway Opening permits.

Any permits for opening local roads or state roads within the Compact Zone shall be the CONTRACTOR'S responsibility.

The COMPANY shall obtain the necessary State Utility Location Permit when working within the State Highway Right-of-Way. If any easement or Inland Wetlands permit is required, MWC will obtain and pay for it.

SUPERVISION OF WORK

The CONTRACTOR shall be solely responsible for supervision of the Work, shall give the Work the constant attention necessary to ensure the expeditious and orderly progress thereof, and shall cooperate with the Engineer in every possible way.

At all times, the CONTRACTOR shall have as his representative on the site a competent superintendent capable of reading and thoroughly understanding the Drawings, Specifications and other Contract Documents, with full authority to execute the directions of the Engineer without delay and to implement all safety rules, precautions and programs required under this Contract and to supply promptly such labor, services, materials, equipment, plant, apparatus, appliances, tools, supplies and other items as may be required. Such superintendent shall not be removed from the site without the prior written consent of the Engineer. If, in the opinion of the Engineer, the superintendent or any successor proves incompetent, the CONTRACTOR shall replace him with another person approved by the Engineer; such approval, however, shall in no way relieve or diminish the CONTRACTOR's responsibility for supervision of the

work or for implementation of all safety rules, precautions and programs required under this Contract.

Whenever the CONTRACTOR's superintendent is not present on any part of the site where it may be necessary to give directions or instructions with respect to such work, such directions or instructions may be given by the Engineer to and shall be received and obeyed by the foreman or any other representative of the CONTRACTOR in charge of the particular work involved. Such superintendent or other representative shall also be responsible for insuring that each of CONTRACTOR's agents, servants, employees and subcontractors observes and complies with all safety rules, precautions and programs required under the "Health, Safety and Protection" and "Safety Compliance" Sections of the General Conditions.

COMPLIANCE WITH LAWS

The CONTRACTOR shall keep himself fully informed of all existing and future federal, state, and local laws, ordinances, rules, and regulations affecting those engaged or employed on the Work, the materials and equipment used in the Work and the conduct of the Work, and of all orders, decrees and other requirements of bodies or tribunals having any jurisdiction or authority over the same. If any discrepancy or inconsistency is discovered in the Drawings, Specifications or other Contract Documents or in the Work in relation to any such law, ordinance, rule, regulation, order, decree or other requirement, the CONTRACTOR shall forthwith report the same to the Engineer in writing. The CONTRACTOR shall at all times observe and comply with, and cause all his agents, servants, employees and subcontractors to observe and comply with all such existing and future laws, ordinances, rules, regulations, orders, decrees and other requirements, and he shall protect, indemnify and save harmless MWC, its officers, agents, servants and employees from and against any and all claims, demands, suits, proceedings, liabilities, judgments, penalties, losses, damages, regulatory fines, costs and expenses, including attorneys' fees, arising from or based upon any violation or claimed violation of any such law, ordinance, rule, regulation, order, decree or other requirement, whether committed by the CONTRACTOR or any of his agents, servants, employees or subcontractors; provided, however, that the foregoing indemnity shall not extend to a case involving liability for damage arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of any such indemnities.

ANTI-HARASSMENT

MWC is committed to maintaining a work environment free of discrimination. Contractor agrees that in the course of providing services under this Agreement, it shall comply with all federal, state

and local laws relating to equal opportunity and non-discrimination in employment.

HEALTH, SAFETY AND PROTECTION

The CONTRACTOR shall take all necessary and appropriate precautions for the safety of, and shall provide necessary and appropriate protection to prevent damage, injury or loss to:

1. All agents, servants, employees or subcontractors of the CONTRACTOR involved in the Work and other persons who may be affected thereby, including without limitation the agents, servants, employees and subcontractors of MWC, the Engineer, MWC's other CONTRACTORs and adjoining property owners and other persons on or nearby the Site:

2. All Work and materials and equipment incorporated or to be incorporated therein, whether in storage on or off the Site, under the care, custody or control of the CONTRACTOR or any of his agents, servants, employees or subcontractors; and

3. Other property at the Site or adjacent thereto, including without limitation trees, shrubs, lawns, walks, pavements, roadways, structures and utilities.

The CONTRACTOR shall be solely responsible for initiating, implementing, maintaining, supervising, enforcing and assuring compliance with safety rules, precautions and programs which satisfy and comply with all federal, state and local laws, rules, regulations, orders, codes and standards applicable to the performance of the Work, including but not limited to all occupational safety and health standards and requirements adopted or recognized under the Occupational Safety and Health Act of 1970, 29 C.F.R. Part 1926; 29 C.F.R. Part 1910;

The CONTRACTOR shall also cause all of his agents, servants, employees and subcontractors to observe and comply at all times with all such safety rules, precautions and programs.

The CONTRACTOR shall observe and comply with all federal, state and local environmental and health laws, rules, regulations, orders, codes and standards applicable to the handling, disposal, storage, generation or management of any "hazardous substance" as defined in 42 U.S.C. §9601.

The CONTRACTOR shall be responsible for establishing hazard communication programs to transmit information on the hazards of chemicals and other substances being used, and all related matters of

safety, to all of his agents, servants, employees and subcontractors by means of labels on containers, material safety data sheets, training programs and any other reasonable safeguards and procedures for safety and protection, in accordance with 29 C.F.R. Part 1926.20.

The COMPANY maintains a file, available to the CONTRACTOR, of Material Safety Data Sheets at each Division Office. It is the CONTRACTOR's responsibility to make his personnel aware of the hazards associated with the materials furnished by The COMPANY and the safety precautions suggested for handling and use.

If the COMPANY or its Inspector or Engineer observes any conditions which do not comply with the requirements of this Contract, MWC may instruct the CONTRACTOR's superintendent or other representative to promptly correct such noncomplying conditions. If such non-complying conditions are not promptly corrected by the CONTRACTOR, MWC may, at its option, either (i) at no additional cost to MWC and with no extension of the completion schedule for the Work, order the Work stopped until the noncomplying condition has been corrected, (ii) correct such noncomplying condition and back charge the CONTRACTOR for any costs incurred in connection therewith, or (iii) terminate this Contract by written notice to the CONTRACTOR.

The CONTRACTOR shall provide sufficient, proper and safe facilities at all times for the inspection or observation of the Work and Site by MWC and its authorized representatives, including without limitation such facilities as are necessary to permit MWC and such representatives to observe compliance with all safety rules, precautions and programs required under this Contract.

While MWC may provide the CONTRACTOR with assistance in monitoring safety rules, precautions and programs, and MWC may correct noncomplying conditions which the CONTRACTOR has failed to correct promptly, such action shall in no way obligate MWC to conduct safety inspections or identify or correct noncomplying conditions, nor will it relieve the CONTRACTOR from any obligations prescribed above, all of which shall remain the sole responsibility of the CONTRACTOR.

CONTRACTOR shall protect, indemnify and save harmless MWC, the Engineer and their respective officers, agents, servants and employees from and against any and all claims, demands, suits, proceedings, liabilities, judgments, penalties, losses, damages, costs and expenses, including attorneys' fees, arising from or based upon any

violation or claimed violation of any of the provisions of the Supervision of Work, Compliance with Laws, and the Health, Safety and Protection, and Safety Compliance Sections of these general conditions; provided, however, that the foregoing indemnity shall not extend to a case involving liability for damage arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of any such indemnity.

SAFETY COMPLIANCE

The CONTRACTOR shall take all necessary precautions and provide all necessary safeguards to prevent personal injury and property damage. The CONTRACTOR shall provide protection for all persons including but not limited to his employees and employees of other CONTRACTORs or subcontractors; members of the public; and employees, agents, and representatives of the Owner, the Engineer, and regulatory agencies that may be on or about the Work. The CONTRACTOR shall provide protection for all public and private property including but not limited to structure, pipes, and utilities, above and below ground.

The CONTRACTOR shall provide and maintain all necessary safety equipment such as fences, barriers, signs, lights, walkways, guards and fire prevention and firefighting equipment and shall take such other action as is required to fulfill his obligations under this subsection.

The CONTRACTOR shall also be familiar with MWC's Safety Manual and comply with all applicable sections.

TERMINATION

Termination for Convenience.

MWC shall have the right to terminate this Agreement, in whole or in part, for its sole convenience at any time by giving seven (7) days prior written notice thereof (the "Termination Notice") to Contractor; provided that MWC acknowledges and agrees (i) that MWC's right to terminate this Agreement for convenience stated herein is discretionary and (ii) that MWC shall act in good faith in any exercise of such discretion. If MWC elects to terminate this Agreement pursuant this section, then Contractor shall, at MWC's request and expense cease all further Work related to the portion of the Work that is terminated, except such Work as MWC may specify in the Termination Notice for the sole purpose of reasonably protecting that part of the Work already executed.

Termination Payment.

In the event of termination for convenience by MWC, MWC shall pay to Contractor a cancellation fee (the "Termination Payment"). Payment of the Termination Payment shall be the sole and exclusive

liability of MWC, and the sole and exclusive remedy of Contractor, with respect to termination of this Agreement for convenience. The Termination Payment shall consist of (a) amounts due, but not yet paid, for Work performed prior to the effective date of termination; (b) reasonable and documented direct costs paid, contracted or for which Contractor is liable, in accordance with the contract, at the time of termination that are in addition to amounts otherwise paid or due as of the effective date of termination; (c) reasonable and documented costs reasonably incurred by Contractor in protecting the Work; and (d) an additional payment equal to fifteen percent (15%) of the aggregate amount of clauses (b) and (c) of this Section. It is understood and agreed by the Parties that Contractor would be damaged by MWC's termination of this Agreement for convenience and that (i) it would be impracticable or extremely difficult to fix the actual damages resulting therefrom; (ii) the termination fee described above is in the nature of liquidated damages and not a penalty and is fair and reasonable; and (iii) such payment represents a reasonable estimate of fair compensation to Contractor for the losses that may reasonably be anticipated from such termination.

Deductions from Termination Payment. MWC shall not be required to pay any portion of the Termination Payment, or (because of subsequently discovered evidence or subsequent observations) may make a demand for repayment of any portion of the Termination Payment previously made to Contractor, to the extent of amounts due or costs incurred in respect of: liens filed against the System, or any portion thereof, by Subcontractors or any other Person entitled to payment from Contractor or a Subcontractor; provided that, MWC has paid all amounts due hereunder to Contractor; failure or refusal of Contractor to make payments to any Subcontractor when due; provided that, MWC has paid all amounts due hereunder to Contractor; and any representation or certification of Contractor made in this Agreement to MWC that proves to be materially false and that materially and adversely affects the Work.

<u>Termination Upon Contractor's Default</u>
A "Contractor Event of Default" will have occurred if:
any representation or warranty made by Contractor herein is false or misleading in any material respect when made or Contractor fails to perform any of its material obligations contained in this Agreement (other than such covenants or agreements specifically addressed in other provisions of this Section) and such false representation or warranty or failure of performance is not corrected or cured within ten (10) Business Days after written notice from MWC; provided, that if such false representation or warranty or failure of performance is not

capable of cure or correction within such ten (10) Business Day period, then such period shall be deemed extended up to an additional thirty (30) Business Days so long as Contractor commences and diligently pursues such cure or correction;

Contractor abandons the Work;

Contractor is insolvent or if any proceeding is instituted against it seeking to adjudicate Contractor as bankrupt or insolvent and remains undismissed after a period of ninety (90) days, or Contractor makes a general assignment for the benefit of its creditors, has a trustee or receiver appointed for its property, or files a petition to take advantage of any insolvency laws;

Contractor fails or refuses to perform any material obligation under the Agreement within thirty (30) days of receipt of written notice from MWC specifying in reasonable detail the basis therefore;

Contractor fails or refuses to comply in any material respect with any Applicable Laws or Applicable Permits within thirty (30) days of receipt of written notice specifying in reasonable detail the basis therefor; or

Contractor fails to bond against or contest and remove any liens filed against the System or any other property of MWC by any of its Subcontractors after Contractor has received payment in full from MWC in connection with the claims which have been filed.

Termination Due to Contractor's Force Majeure Event

In the event that a Force Majeure Event prevents Contractor from performance of the Work and continues for a period of more than ninety (90) days, then MWC shall be entitled to serve thirty (30) days written notice upon the Contractor of its intent to terminate this Agreement and, if at the end of such thirty (30) day period such Force Majeure Event continues, then MWC may terminate this Agreement without further notice to Contractor.

Actions Upon Termination

If MWC terminates this Agreement due to a Contractor Event of Default or a Force Majeure Event, Contractor shall take such actions as are necessary to protect the Work.

Consequences of Termination

Upon the occurrence and during the continuation of any Contractor Event of Default, MWC may, without prejudice to any other right or

remedy that it may have, terminate this Agreement by written notice to Contractor. Upon such termination due to a Contractor Event of Default, Contractor shall not be entitled to receive any further payments under this Agreement. If the MWC has terminated this Agreement due to a Contractor Event of Default, and it is determined that no such default has occurred, then the termination shall be considered a termination for convenience as described above.

Surviving Obligations

Termination or completion of this Agreement shall not relieve Contractor or MWC of any obligation hereunder which expressly or by implication survives termination or completion hereof and, except as otherwise provided in any provision of this Agreement expressly limiting the liability of either Party (such limitations which shall survive termination and completion), shall not relieve either Party of any obligations or liabilities under the terms hereof for loss or damage to the other Party arising out of or caused by acts or omissions of such Party prior to the completion or effectiveness of such termination or arising out of such termination, and shall not relieve either Party of its obligations as to portions of the Work already performed or of obligations assumed by either Party prior to the date of termination.

WATER

Upon notification by the CONTRACTOR to the COMPANY water required for reasonable use in the construction and testing of the work may be secured by the CONTRACTOR, without cost, from an approved water main location, as available. The CONTRACTOR shall lay all connecting lines of such size as are necessary for his operations.

TEMPORARY WATER

In the event temporary water service is required, the COMPANY may complete the work in advance of the CONTRACTOR'S commencement of work date, as denoted on the Notice to Proceed. If temporary water is included within the CONTRACTOR's scope of work, it will be included as a lump sum within the bid form and included in the measurement and payment. Regardless of who installed temporary water, The CONTRACTOR is required to protect temporary water service throughout the duration of contract. These tasks will be incidental to the project.

COMMENCEMENT OF WORK

The CONTRACTOR shall commence work on the site within seven days after notice from MWC to do so. CONTRACTOR shall commence work at such points as MWC shall direct and shall thereafter continue at such points and in such order of precedence as MWC may from time to time direct. CONTRACTOR shall notify MWC whenever his construction crew is at the job site.

TIME OF COMPLETION	Individual projects or portions of projects may have specific schedule requirements due to community schedules, coordinating project deadlines and conditions beyond the control of MWC. Any specific project schedule requirements will be identified on the respective bid forms. The CONTRACTOR understands MWC has obligations to meet project completion times as defined on the respective contract documents and may impose liquidated damages, as outlined in the agreement, should the projects exceed their completion dates.
EMPLOYMENT OF SUFFICIENT LABOR AND EQUIPMENT	If in the sole judgment of the Inspector the CONTRACTOR is not employing sufficient labor, plant, equipment or other means to complete the Work within the time specified, the Inspector may, after giving written notice, require the CONTRACTOR to employ such additional labor, plant, equipment and other means and as the Inspector deems necessary to enable the Work to progress properly.
CONTRACT DRAWINGS	Contract drawings (when available) and these specifications are complementary. What is called for by one shall be considered called for by both.
DELAYS	The CONTRACTOR is hereby specifically notified that MWC assumes no responsibility for delays.
MATERIALS AND WORKMANSHIP	All materials and workmanship, except where otherwise specifically mentioned, shall be the best of their several kinds and subject to the approval of the Inspector or other designated COMPANY official.
LINES, GRADES AND MEASUREMENTS	For work requiring lines, grades and measurements, the CONTRACTOR shall employ a competent surveyor to establish all lines, elevations, reference marks, batter boards, etc., needed by the CONTRACTOR during the progress of the Work, and from time to time to verify such marks by instrument or other appropriate means. The Engineer shall be permitted at all times to check the lines, elevations, reference marks, batter boards, etc., set by the CONTRACTOR, who shall correct any errors in lines, elevations, reference marks, batter boards, etc., disclosed by such check. Such a check shall not be construed to be an approval of the CONTRACTOR's work and shall not relieve or diminish in any way the responsibility of the CONTRACTOR for the accurate and satisfactory construction and completion of the entire work. For his work, the CONTRACTOR shall make, check, and be responsible for all measurements and dimensions necessary for the proper construction of and the prevention of misfitting of work.

During the course of the project the CONTRACTOR shall be responsible for recording the necessary As-built information in accordance with MWC's Field Note Requirements as indicated within.

INSPECTION DURING CONSTRUCTION

MWC will appoint an Inspector to inspect all materials and workmanship and to see that the work conforms with the specifications and drawings.

The failure of the Inspector to reject or condemn improper materials and workmanship shall not prevent MWC from rejecting materials and workmanship found defective at any time prior to the final acceptance of the completed work, nor shall it be considered as a waiver of any defects which may be discovered later, or as preventing MWC at any time subsequently from recovering damages for work actually defective.

The CONTRACTOR shall provide sufficient, safe and proper facilities at all times for inspection, including every reasonable facility for examining and inspecting the work and for ascertaining that the Work is being performed in accordance with the requirements and intent of the Contract, even to the extent of requiring the uncovering of portions of finished work by the CONTRACTOR.

Should the work thus uncovered prove satisfactory, the cost of uncovering and the replacement thereof shall be considered as extra work unless the original work was done in violation of the Contract in point of time or in the absence of the Inspector and without his written authorization, in which case said cost shall be borne by the CONTRACTOR. Should the work uncovered prove unsatisfactory, said cost shall be borne by the CONTRACTOR.

EXTRA WORK

MWC may order any extra work done by issuing a "Change Order" in writing, signed by MWC. The CONTRACTOR shall accept as full compensation for extra work so performed, the lump sum or unit prices mutually agreed upon before starting the work, or, at the discretion of MWC, the actual cost of the work plus fifteen (15%) percent. The actual cost of the work shall include the cost of all materials, supplies and labor necessary for the performance of the extra work but shall not include the cost of general superintendence, overhead charges, depreciation of plant or the cost of rental of small tools.

No claim for extra work will be allowed unless a "Change Order" in writing has been issued covering the work.

CLAIMS FOR DAMAGES	If the CONTRACTOR makes claim for any damages alleged to have been sustained by breach of contract or otherwise, shall, within ten (10) days after occurrence of the alleged breach or within ten (10) days after such damages are alleged to have been sustained, whichever date is the earlier, file with MWC a written, itemized statement in triplicate of the details of the alleged breach and the details and amount of the alleged damages. The CONTRACTOR agrees that unless such statement is made and filed as so required, his claim for damages shall be deemed waived, invalid and unenforceable, and that he shall not be entitled to any compensation for any such alleged damages.
ASSIGNMENT OF CONTRACT AND SUBCONTRACT	No assignment or transfer of the contract, or of any money or moneys due or to become due thereunder, and no subletting of the work or any part of the work under the contract will be permitted without prior written approval of MWC.
MEASUREMENT OF UNIT ITEMS	Measurement of the items of the work which are to be for on a unit basis will be made by MWC as the work progresses, and the CONTRACTOR's monthly estimates shall conform to the measurements. The CONTRACTOR shall have the right to have a representative present when measurements are being made, to check the measurements and to call MWC's attention to any errors or omissions. If the CONTRACTOR's measurements exceed MWC's measurements, CONTRACTOR shall have the right to demand one (1) re-measurement before his estimates are submitted and the amount so measured shall be final. If the CONTRACTOR fails to have a representative present after due notification, shall forfeit the right to demand a re-measurement. Measurements for rock excavation and asphalt paving will be based on actual field measurements and limited to the specified pay limit. Should areas require restoration due to the negligence from the CONTRACTOR's operations (i.e. over-excavating, ripping up pavements, unnecessary lawn damage, etc.) all costs for restoration out of the normal work area will be at the CONTRACTOR's expense.
INSURANCE COVERAGE	The Contractor shall obtain the required insurance as indicated on attached Insurance Certificate and shall submit duplicate copies of the executed forms upon execution of this Proposal and Contract. The Contractor shall also provide said copies upon Certificate renewal as appropriate throughout the term of the agreement. In addition to the submission of the aforementioned Certificate, MWC requires a blanket Additional Insured Endorsement. This insurance shall apply as Primary and non-contributing insurance before any other

	insurance or self-insurance, including any deductible, maintained by, or provided to, the additional insured. Further, MWC requires ISO Additional Insured Endorsements CG 2010 and CG 2037, or equivalent. In the event insurance is cancelled, MWC requires a minimum of 30 days-notice of policy cancellation. Contractor shall maintain CGL coverage for itself and all additional insureds for the duration of this agreement and maintain Completed Operations coverage for itself and each additional insured for at least 1 year after the completion of each project completed under the term, or extended term of this agreement.
WAIVER OF SUBROGATION	Contractor waives all rights against MWC and their agents, officers, directors and employees for recovery of damages to the extent these damages are covered by commercial general liability, commercial umbrella liability, business auto liability or workers compensation and employers liability insurance maintained by the requirements stated or referred to in the insurance section above.
ASSURANCE STATEMENT	The CONTRACTOR shall complete and return an Assurance Statement if the work under this Agreement is being performed for MWC under the terms of a DOT Utility Construction Agreement. This will be provided as a Supplement on appropriate projects.
TAXES	The Maine Water Company is not tax exempt for Sales Tax purposes in the construction of real and/or tangible personal property as defined in "§1752 (17)" of the Maine State Sales and Use Tax laws. Therefore, water distribution property, plant and equipment are subject to Maine State Sales tax. CONTRACTORs should include Sales Tax per the Maine State Sales Tax laws and rates when considering pricing of bids for construction of property not used in the production of treated potable water such as main installations. An exception is made in the construction and operations of the water production process. MWC will provide the required tax exemption certificate for purchases of all materials required for the completion of projects related to water production.
GENERAL GUARANTEE	The CONTRACTOR agrees from and after the date upon which the final completion is formally approved by MWC to guarantee all work for a period of one (1) year. Also, CONTRACTOR shall during this period promptly repair all breaks, failures or defects which develop in his work as a result of faulty material or workmanship furnished by him at no cost to the Owner.

If he cannot perform such work promptly, he agrees to pay the reasonable cost for such repairs as performed by MWC or its agents.

COMPUTATION OF PAVEMENT

Pavement quantities measured for payment shall be determined by the following conversion: Ton = (0.055) sq. yds. per inch thickness. The exception to this is bituminous curbing which will be measured per linear foot.

PAYMENTS

Payments will be made for 95 percent of the work completed through the billing period established (monthly) to date, through the last day of the week. No payments will be made for any work other than the sum of the unit prices bid by the CONTRACTOR except upon a written Change Order executed prior to the beginning of the work for which extra payment is requested. The 5 percent of all payments withheld will be released upon successful completion of the contract, as determined by MWC.

JOB MEETINGS

The CONTRACTOR will be required to meet within two weeks after the award of the contract for a preconstruction meeting and periodically thereafter with COMPANY representatives to discuss scheduling, sequence of operations, and coordination of the work.

CARE AND RESTORATION OF PROPERTY

The CONTRACTOR shall enclose the trunks of trees adjacent to his work that are not to be cut, with substantial wooden boxes of such height as may be necessary to protect them from injury from piled material, from equipment, from his operations, or otherwise due to his work. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

Branches, limbs, and roots shall not be cut except by permission of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. In case of cutting or unavoidable injury to branches, limbs, and trunks of trees, the cut or injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.

If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kind and quality at least equal to the kind and quality existing at the start of the work at no additional cost to MWC. Any damage to pipes, drainage structures or other utilities, whether active or abandoned, shall be repaired by the CONTRACTOR at no additional cost to MWC.

All surfaces which have been injured by the CONTRACTOR's operations shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

DIG SAFE

In Maine, anyone using power tools to penetrate the ground (including homeowners) is required to notify DIGSAFE at 811 or 1-888-DIGSAFE at least 3 business days prior to digging. DIGSAFE will then notify the owners of underground facilities that are members of that system. However, not all owners of underground facilities are required to be members of the DIGSAFE system.

This directory, the Maine Public Utilities Commission's **"OK-TO-DIG"** directory, provides contact information for the non-member, underground facility operators. You may also access this directory with a touch-tone phone at **1-866-OKTODIG (1-866-658-6344).**

The CONTRACTOR must comply with all current MPUC Facility Damage Prevention Regulations.

CONTRACTOR'S RESPONSIBILITY FOR MATERIALS AND EQUIPMENT

The CONTRACTOR shall assume full responsibility for all supplies, materials and equipment required for the contracted work, whether furnished by the CONTRACTOR or by MWC until final acceptance.

CLEANING UP

During its progress, the work and the adjacent areas affected thereby shall be kept cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes or structures, in connection with work done under this contract, or elsewhere during the course of the CONTRACTOR's operation, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipe structures, and work, etc., shall upon completion of the work be left in a clean and neat condition.

On or before the completion of the work, the CONTRACTOR shall, unless otherwise specifically directed or permitted in writing, tear down and remove all temporary buildings and structures, shall remove all temporary works, tools, and machinery or other construction equipment used for construction, shall remove all rubbish from any grounds which he has occupied, and shall leave the roads and all parts of the premises and adjacent property affected by the project, in a neat and satisfactory condition.

The CONTRACTOR shall not dispose of any excess excavated materials on the adjacent properties, unless written approval has been secured from the property owner. The CONTRACTOR shall furnish to MWC a copy of the property owner's approval prior to the disposal of any materials.

The CONTRACTOR shall restore or replace, when and as directed, any public or private property damaged by work performed under this contract, equipment or employees to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the CONTRACTOR shall do as required all necessary highway or driveway, walk and landscaping work. Suitable materials, equipment and methods shall be used for such restoration.

SECTION II

TRENCHING, BACKFILLING AND INSTALLING WATER MAINS AND APPURTENANCES

WORK TO BE DONE

The work to be done includes furnishing all materials, labor, tools, plant and equipment required for receiving, inspecting, hauling and distributing materials, removing pavement; excavation and backfill; and installing, disinfecting and testing the water piping and appurtenances including valves and fittings; providing As Built installation sketches; all as shown on the drawings, (when available) specified herein or ordered by MWC; complete in every detail, ready for operation.

HANDLING AND HAULING MATERIALS

MWC will furnish all pipe, fittings, valves and appurtenances required for the work as hereinbefore specified. The CONTRACTR shall receive, inspect, handle, haul, store, protect and distribute them as required for the work. Protection of the pipe is defined as bagging the pipe to reduce the risk of dirt, leaves, animals, or any other material harmful to the pipe, system, or disinfection process. Payment of this work is within Section D. Site Management of the bid form.

EXCAVATION AND BACKFILLING

The CONTRACTOR shall perform all necessary excavation and backfilling called for in these specifications or as required by MWC, including the necessary sheeting, shoring, pumping, bailing, supporting and protecting existing structures and repairing them when damaged, and removing or altering existing underground obstructions which are owned by private parties.

All excavation shall be classified as earth excavation or rock excavation.

Earth excavation shall include sand, gravel, ashes, loam, clay, swamp muck, soft or disintegrated rock or hardpan which can be removed with a pick, or a combination of such materials, and boulders measuring less than one (1.0) cubic yard whether the boulders are broken or removed intact.

ADDITIONAL EXCAVATION

If, in the opinion of MWC, the material below normal grade of the excavation is unsuitable for foundation, it shall be removed and disposed of to such limits as MWC may direct.

The quantity of additional excavation is to be paid for under unit items in Section E. Excavation and Restoration. Volumes shall be

measured in place for payment equal to the number of cubic yards within the normal trench excavation limits, not to exceed 6 feet wide or 3 feet thick unless approved by MWC. All work must be agreed to in advance by Contractor and MWC.

Select backfill specifications must meet the standards of the State or local highway authority and be approved by MWC in advance of purchase or placement.

The unit price shall constitute full compensation for excavation and disposal, backfilling, and for furnishing any additional material needed for backfilling.

PROTECTION OF THE PUBLIC

Improved streets, roads, driveways and sidewalks shall be kept open over all trenches and excavations and the use thereof rendered safe by the construction of substantial timber bridges with proper handrails where required.

TRAFFIC CONTROL

Traffic control will be the responsibility of the CONTRACTOR. All costs for all traffic control and planning shall be included as a lump sum price defined in Section D. Site Management. Traffic control shall follow Standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD) and is to be provided to the satisfaction of MWC and the governing authority. The CONTRACTOR is required to prepare and submit for review and approval a traffic control plan, specific to this project, which is prepared in accordance with MUTCD standards.

BARRICADES, FLASHERS AND SIGNING

Any construction equipment plant, materials or obstruction placed on streets, roads or walks, and all open excavations shall be carefully marked and protected by barricades with flashers and construction safety fence.

The CONTRACTOR shall supply, place, and maintain traffic signs and cones to the extent necessary to provide the signing pattern(s) required by the state, local, or governing agency or as requested by MWC.

NIGHT WORK

Any work conducted before sunrise or after sunset shall be considered Night Work. Night work shall require the Contractor to provide and maintain lighting on all equipment, at all work stations, and all flagger stations.

The lighting facilities shall be capable of providing light of sufficient intensity to permit good workmanship, safety and proper inspection at

all times. All workers shall wear safety apparel labeled as meeting the ANSI 107-2004 standard performance for Class 3 risk exposure, along with a hardhat with 360° retro-reflectivity. Flaggers shall utilize retro-reflective or flashing SLOW/STOP paddles.

The CONTRACTOR shall submit a lighting plan at the pre-construction meeting, showing the type and location of lights to be used for night work. MWC may require modifications be made to the lighting set up in actual field conditions.

MWC reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. MWC shall not be held responsible for any delay in the work due to any suspension under this item. Failure to follow the approved lighting plan will result in a traffic control violation. Payment for lighting, signs and other costs accrued because of night work will be paid under Section D. Site Management.

ROADWAYS TO BE KEPT CLEAR

The CONTRACTOR shall dispose of construction and excavated materials so as not to obstruct streets, roads, and highways or private rights of way. The CONTRACTOR shall not obstruct the gutter of any street, road or highway, but shall take such measures as will insure the free passage of surface and storm waters along the gutters. All excavated materials shall be placed in a neat manner on one side of the trenches and shall be kept trimmed up so as to inconvenience the traveling public and adjacent property owners as little as possible. The utmost care shall be used to avoid interference with the ordinary use of the existing streets, roads or highways.

No portion of any street shall be closed to traffic unless written permission of the proper Traffic Authorities has first been obtained.

DUST CONTROL

The CONTRACTOR shall keep on the job sufficient supplies of calcium chloride to be applied at locations and at such times and in amounts as directed for the purpose of allaying dust conditions. Roadway sweeping with water shall be performed at the end of each workday to remove all debris from the roadway surface. The cost of such work in incidental to the project and shall be included in any and all items including but not limited to excavation, backfilling and laying of water main.

OBSTRUCTIONS

The CONTRACTOR shall lay the pipes or pipe lines through or around all permanent obstructions which may be encountered on or below the surface, and make all necessary removals or alterations of existing underground structures which are owned by private parties.

The attention of the CONTRACTOR is directed to the fact that there may be existing sanitary sewers and laterals, gas and water mains with services in all streets along with telephone, electric, cable TV or other underground utilities. MWC will furnish assistance to the CONTRACTOR in establishing the location of these systems on the site. If the CONTRACTOR should damage or break any of the above items, he shall repair the damaged service at his own cost.

REMOVING PAVEMENTS

Where existing streets, road or highways are paved within the the limits of the trench, such pavement or surfacing shall be removed to the extent necessary for the work.

Prior to pavement removal, the pavement shall be cut by jackhammer, wheel, or saw cut at the CONTRACTOR's expense. Saw cutting of pavement shall also be required prior to permanent pavement placement. All saw cutting will be incidental to items within Sections A, B, C, and E on the bid form.

DIMENSIONS

The width of trenches shall be sufficient to permit proper alignment of the pipes and thorough tamping of the backfill around and under the pipes in their final location. There shall be at least twelve (12) inches clear opening at all points between the outside of the pipe and the sides of the trench. Where trenches are sheeted, the specified clear opening shall be provided between the inside face of the sheeting and the outside of the pipe.

All water mains shall be installed as shown on the plans. The minimum depth of cover shall be as follows.

Millinocket	6.5’
Greenville	6.5’
Skowhegan/Oakland/Hartland	5.5’
Bucksport	5.0’
Camden/Rockland/Rockport	5.0’
Freeport	5.0’
Kezar Falls	5.0’
Biddeford Saco	5.0’

For the crossing of sewers, storm drainage or other utilities the water main shall be laid to the elevations as shown on the plans or as directed by the Inspector but in no case shall the separation between the two be less than 18" vertical unless specifically approved by the Inspector.

Where necessary to avoid existing structures, to secure suitable foundations or to conform to future grading of streets or sidewalks, a greater or lesser depth may be authorized by MWC. If the trench is

excavated to a depth greater than specified or authorized, the CONTRACTOR shall refill the trench to the required depth with suitable material thoroughly tamped.

TRENCHING

In excavating trenches, the CONTRACTOR may use such methods as MWC will approve. Where the use of trenching machines is permitted, The CONTRACTOR shall before starting work, obtain all available information as to the location of existing underground structures, and shall plainly mark their location in advance of the excavation. The length of trench excavated ahead of the pipe laying, and the length of trench which may remain open at one time shall at all times be subject to the approval of MWC. It shall at no time be greater than can properly be protected from caving.

TUNNELING

Excavation shall be made in open cut. No tunneling will be permitted unless under authorization of MWC.

SHEETING, BRACING AND COFFERDAMS

To prevent injury to the work or delay in construction, all excavations shall be maintained in good order and all necessary precautions taken to prevent movement of the sides.

HANDLING OF WATER

The CONTRACTOR shall at all times take such precautions as are necessary to keep the work free from ground or surface water. The CONTRACTOR shall provide pumps of adequate capacity to remove from the excavations the water which may enter and in such a manner that it will not interfere with the progress of the work or the proper placing of the pipe. Proper sedimentation and erosion control measures shall be taken to assure compliance with DEP regulations.

BACKFILL

Backfilling material for at least one (1) foot above the top of the pipe shall consist of selected fine material containing no stones larger than one inch in size. Backfill of the fine selected material shall be carefully and thoroughly tamped with approved tools in such a manner as to prevent settlement. Special care shall be taken to place the best sandy or gravelly material under the pipe on the quarters and to bring it up solidly so as to furnish a hard bed for the whole of the lower part of the pipe.

The required backfill above the one-foot layer of fine selected material shall be spread in layers not exceeding twelve (12) inches in depth prior to compaction. Each layer shall be carefully and thoroughly tamped with approved tools in such a manner as to prevent settlement after the backfill has been completed and to achieve at least 95% modified proctor density.

The use of frozen material will not be permitted. The excavated paving, either bituminous or other, shall not be placed in the trench as backfill. All settlement in backfill shall be repaired by the CONTRACTOR at no expense to MWC.

Prior to placement of permanent pavement all trenches shall have sufficient compaction to achieve at least 95% modified proctor density.

The cost of backfilling (including required pipe bedding and all backfill material) shall be included in Sections A, B, C, and E on the bid form.

HANDLING MATERIALS

Proper and suitable tools for safe and convenient handling and installation of pipes, fittings and valves shall be used. Great care shall be taken to prevent damage to the protective coating. Minor damage to exterior coating may be patched with asphaltum. Excessively damaged material shall be removed.

CUTTING PIPE

Pipe shall be cut by means of a pipe saw or other approved method in accordance with the manufacturers operating instructions for the equipment to produce a clean true cut, free from irregularities and leave a smooth end at right angles to the axis of the pipe. All bevels shall be made with appropriate grinding equipment.

INSTALLING WATER PIPE

All pipes shall be carefully examined for defects and no piece shall be installed which is known to be defective. If any defective piece is discovered after having been installed; it shall be removed and replaced with a sound one at the expense of the CONTRACTOR. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they have been accepted in the completed work.

JOINTS

All pipe joints will be push-on type rubber gaskets unless otherwise specified. Each push on joint shall receive two (2) brass wedges for pipe 8-inch in diameter and less. All pipe diameters greater than 8-inch receive three (3) wedges. All fittings and valves will be of the mechanical joint type unless otherwise specified.

RUBBER GASKET JOINTS

Rubber gasket joints will be of the compressed rubber ring gasket type. The joints shall be thoroughly cleaned, prepared and installed in strict accordance with the requirements, instructions and recommendations of the joint manufacturer and of MWC.

Only rubber gaskets furnished by the manufacturer of the pipe shall be used. Gaskets which have become damaged or which are defective in

any way shall not be used in the work. Gaskets shall be stored in a cool, dark and dry place and shall be kept warm prior to their use in cold weather. Jointing materials in addition to the gaskets, if required by the type of joint furnished, shall fully comply with and be installed in accordance with the requirements of the manufacturer of the joint. At no time will anything be allowed in the pipe for temporary storage or protection from the elements.

POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be installed in accordance with AWWA standard C105-10 method "A", or latest revision thereof, at locations including all ductile iron pipe, ductile fittings, hydrant laterals and barrels, and any other locations as directed. The polyethylene tube shall be cut to a length approximately two feet longer than that of the pipe section. Slip the tube around the pipe installations including hydrant laterals and barrel to ground level and all associated service lines, three (3) feet from the main connection.

The polyethylene tube shall be cut to a length approximately 2 feet longer than that of the pipe section. Slip the tube around the pipe, providing a 1-foot overlap at each end. Lower the pipe into the trench and make up the pipe joint, overlapping the wrap at the joint. Take up the slack width to make a snug, but not tight, fit along the barrel of the pipe. Repair any rips, punctures, or other damage with adhesive tape or with a short length of polyethylene tube cut open then wrapped around the pipe and secured in place.

APPURTENANCES

The CONTRACTOR shall exercise care in planning the work to arrange for the proper setting of all fittings, valves and other appurtenances required in the completed pipe lines. Fittings shall be properly supported with additional blocking if required to maintain the pipe lines in alignment.

Special attention shall be given to the accurate placing of valves so that they will not be subject to undue strains, and where required by MWC, they shall be supported on sound timber blocking. Valves shall be set with their stems truly vertical. Valve boxes shall be carefully placed to insure the free and proper operation of the valves.

TESTS AFTER INSTALLATION

After the pipe has been installed and backfilled, all newly installed pipe shall be subjected to a pressure and leakage test conducted in accordance with AWWA Standard C600-10, Section 5 and as follows.

A) Pressure Test:

All newly installed pipe shall be subjected to a hydrostatic pressure of 1.5 times the working (system) pressure at the point of testing, but in

no case less than 150 psi at the highest point along the test section. The test pressure shall not exceed pipe or thrust restraint design limits, twice the rated pressure of closed valves or hydrants located within the test area, or the rated pressure of closed resilient-seated gate or butterfly valves. The test shall be maintained for a minimum of one hour with no more than a 5 psi variation during the test period.

B) Leakage Test:

The leakage test will be conducted at the same time as the pressure test. Leakage is the quantity of water required to maintain the pressure within 5 psi of the specified test pressure, it is not the measured drop in pressure. Leakage shall not exceed the number of gallons per hour as determined by the inspector, and is indicated in Table 6 of the above specified AWWA Section.

C) General.

Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow-offs are not available at high places, the CONTRACTOR shall make the necessary taps at points of highest elevation before the test is made and insert the plugs, if desired, after the test has been completed. The section to be tested shall be closed by valves, temporary flanges, plugs or bulkheads as required.

Each isolated section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the inspector. The pipe connection and all necessary apparatus including pump shall be furnished by the CONTRACTOR. The CONTRACTOR shall furnish all necessary labor and materials for conducting the tests.

If leakage is either visible or indicated by the above test procedure, the CONTRACTOR shall do whatever is necessary to locate and repair said leak at his own expense. Any repair method will require pre-approval from MWC. Upon completion of the repair the pipeline shall be retested. All pressure and leakage testing will be incidental to items in Section A. Water Main Installation

DISINFECTION

Before any section of pipeline is put into service; it shall be thoroughly disinfected in accordance with AWWA Standard C651-14, Section 4.4.2.

The completed line shall be slowly filled with water and allowed to stand under pressure for at least 24 hours before being thoroughly flushed. A sample of water from the section shall be collected for analysis in a sterilized bottle at the expense of the CONTRACTOR.

No section of main shall be put into service without the approval of MWC, and should the analysis be unsatisfactory, the section shall be re-disinfected and retested until an analysis satisfactory to MWC is obtained. All costs for re-disinfection and retesting shall be borne by the CONTRACTOR. Temporary taps and blow-offs for disinfection are to be removed and shut off at the corporation upon successful testing. All Disinfection will be incidental to items in Section A. Water Main Installation.

DECHLORINATION

The Contractor shall be responsible for dechlorination. The discharge of water to the environment with chlorine concentrations greater than the ambient distribution system chlorine residual is prohibited. The highly chlorinated water must be dechlorinated satisfactory to MWC before discharge to the environment. Dechlorination will be incidental to items in Section A. Water Main Installation.

SECTION III

Measurement and Payment

Section A: Water Main Installation

Items 810.01-810.03 Water Main Installation

Payment will be made at the Contract Unit Price per linear foot as measured along the axis for the size and class of pipe to be installed, complete in place, as required by MWC. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the trenching and installation of the water main(s). All costs to complete the pipeline installation are included in the unit price per lineal foot of water main. The unit price for each water main includes but is not limited to saw cutting, removal and disposal of pavement, earth excavation, pipe bedding material, installation of water main, polyethylene encasement, fittings, joint bracing, appurtenances, marking tape, tracer wire, standard dewatering and trench maintenance, pressure and leakage testing, disinfection of water main (and de-chlorination of discharge), removal and disposal of excess or unsuitable material, site cleaning and maintenance of street and other surfaces, etc. See trenching details and assumptions on depths.

Additionally, Contractor shall submit schedules, shop drawings and as-built records as required by MWC. See as-built requirement for specifics on accuracy and format. All other items of work not listed elsewhere in the "Water Mains and Maintenance Units" will be paid for inclusive in this bid item.

Section B: Connections to Existing Mains

Items 813.01 Connections to Existing Mains

The Contract Price Unit will be a lump sum by location to connect to an existing main. This lump sum shall include but not limited to all labor and equipment required to make the necessary excavations including shoring, dewatering, installing and testing the tap sleeve, tee, or other specified fittings, as well as the valve installation, removing the existing fittings, or cutting the existing main and installing the required fitting(s). Connections between new and existing mains shall be made at the points shown on the drawings or directed by MWC. The day and time of making connections shall be coordinated with MWC and the method of making them shall be under the full direction of MWC.

Any new water main installed in association to a specific connection will be paid under Section A: Water Main Installation.

Section C: Water Service and Appurtenances

Item 812.01 Temporary Blow Off Assembly
Payment will be made at the Contract Unit Price for each temporary blow off assembly. Temporary blow off assembly shall include all excavation, backfill, setting and installing valves, boxes and riser off the water main as required or as necessary to make a complete and satisfactory installation as well as the permanent retirement of the blow off assembly per MWC specifications. Thrust blocks will be provided by the contractor.

Item 811.01 Hydrant Installation
Payment will be made at the Contract Unit Price for each fire hydrant installation. Fire hydrant installation shall include all excavation, backfill, setting and installing hydrant, gate valve, hydrant tee off the water main, all thrust blocking, polyethylene encasement on barrel, crushed stone, fabric, joint restraint as required or as necessary to make a complete and satisfactory installation. Thrust blocks will be provided by the contractor. All hydrant lateral pipe will be paid under and in accordance with Section A. Water Main Installation.

Section D: Site Management

This section has been omitted intentionally.

Section E: Excavation and Restoration

Item 820.01 Thrust Block
Payment will be made at the Contract Unit Price for each concrete thrust block, installed complete in place at all locations necessary or as directed by MWC to provide a complete and satisfactory installation. The Contract Unit Price shall include all labor, materials, reinforcement, tools and equipment, furnishing and placing concrete and all incidental work required. All thrust blocks must be sized according to drawing details. Thrust blocks shall be installed against undisturbed soil and allow access to joint and fittings for repair. All cast in place concrete must conform to at least 3,000 psi concrete. Any poured in place concrete thrust blocks must first be approved by MWC. All thrust blocks will be provided by the contractor. This item does not include fire hydrant blocking or any other items where thrust blocking is included in the item.

Item 803.01 Test Hole Excavation
Payment will be made at the Contract Price Unit for each test hole excavation. The unit price shall include all cost of materials, labor, tools, and equipment required for excavation and backfill where ordered by MWC.

Test Holes shall be excavated in advance of pipe installation where directed by MWC to determine the occurrence, location and dimensions of existing sub-surface structures and character of foundation material. They shall be backfilled in the same manner and with material similar to that specified for the upper portion of pipe trenches.

The quantity of test hole excavation to be measured for payment under this item shall be equal to the number of cubic yards measured in place within the normal trench excavation limits, not to exceed 6 feet wide unless approved by MWC.

SECTION IV

AGREEMENT

WATER MAIN REPLACEMENT CROSSING UNDER MAINE TURNPIKE IN SACO

STATE ROUTE 112 & MAINE TURNPIKE

I (we) certify that I (we) have read this Agreement, and the Specifications for Trenching, Backfilling and Installing Water Mains and Appurtenances and fully understand the meaning and hereby agree that if awarded the Contract, I (we) will comply with all of the terms, covenants and agreement set forth herein.

I (we) agree that the interpretation of the specifications, and all decisions relating to the quantity and quality of materials, equipment and workmanship shall rest with The Maine Water Company (hereinafter designated as MWC) or with any inspector whom MWC may designate.

Should the CONTRACTOR at any time refuse or neglect to supply a sufficiency of properly skilled workmen or of materials of the proper quality, or fail in any respect to prosecute the work with promptness and diligence or fail in the performance of any of the Agreement, or the Specifications, and such refusal, negligence or failure being certified by the Inspector, MWC shall be at liberty after three (3) days written notice to the CONTRACTOR to provide any such labor or materials and to deduct the cost thereof from any money then due or to become due to the CONTRACTOR under this Agreement, and if the Inspector shall certify that such refusal, negligence or failure is sufficient ground for such action, MWC shall be at liberty to terminate the employment of the CONTRACTOR on said work and to enter upon the premises and take possession, for the purpose of completing the work included under this Contract, of all materials, tools and appliances thereon and to employ any other person or persons to finish the work and to provide the materials therefor. In case of such discontinuance of the employment of the CONTRACTOR, he shall not be entitled to receive any further payment under this Contract until the said work shall be wholly finished, at which time, if the unpaid balance of the amount to be paid under this Contract shall exceed the expense incurred by MWC in finishing the work, such excess shall be paid by MWC to the CONTRACTOR, but if such expense should exceed such unpaid balance, the CONTRACTOR shall pay the difference to MWC. The cost of completing the work shall be evidenced by the bills actually paid by MWC for this purpose if the work is completed by the employment of other CONTRACTOR or CONTRACTORs, or shall be MWC's actual cost if the work is completed by MWC personnel.

Should the CONTRACTOR be delayed in the prosecution or completion of the work by any act, neglect or default of MWC or his agents or by any damage caused by fire, lightning, earthquake, cyclone or strikes or any casualty for which the CONTRACTOR is not responsible, then the time hereinafter fixed for the completion of the work will be extended for a period equivalent to the time lost by reason of these causes. The length of the extended period, if any, shall be determined and fixed by the Inspector but no allowance will be made unless request therefor is presented to MWC in writing within forty-eight (48) hours after occurrence of the delay, nor unless the request is approved in writing by the Inspector.

AGREEMENT

WATER MAIN REPLACEMENT CROSSING UNDER MAINE TURNPIKE IN SACO

STATE ROUTE 112 & MAINE TURNPIKE

Except as otherwise stated below, once the CONTRACTOR's Bid is submitted and received by MWC for consideration and comparison with other bids similarly submitted, the CONTRACTOR agrees that he may not and will not withdraw the Bid within 90 days after the actual date of the opening of Bids.

Upon proper written request and identification, Bids may be withdrawn only as follows:

1. At any time prior to the designated time for the opening of Bids.

2. Provided the Bid has not theretofore been accepted by MWC, at any time subsequent to the expiration of the period during which the bidder has agreed not to withdraw his Bid.

Unless a Bid is withdrawn as provided above, the bidder agrees that it shall be deemed open for acceptance until the Agreement has been executed by both parties thereto or until MWC notifies a bidder in writing that his Bid is rejected or that MWC does not intend to accept it. Notice of acceptance of a Bid shall not constitute rejection of any other Bid.

The Maine Water Company reserves the right to reject any and all bids for any reason after acceptance.

I (we) agree to receive as full compensation for furnishing and delivering all materials, labor, tools, plant and equipment and performing the work required for constructing the pipe lines, complete and finished in every detail, ready for operation, in full accordance with the specifications and contract drawing(s) which are hereby made part and parcel of this Agreement, at the unit prices put forth in the respective Bid Form for each project.

I (we) agree to complete the installation of the water main, service tie overs and temporary pavement necessary for substantial completion and final restoration work which may include asphalt paving sidewalk repairs, etc. by the final completion deadline put forth in the Notice of Award barring strikes, accidents or other delays caused by conditions beyond my (our) control. Substantial and final completion will be determined by the MTA.

AGREEMENT

WATER MAIN REPLACEMENT CROSSING UNDER MAINE TURNPIKE IN SACO

STATE ROUTE 112 & MAINE TURNPIKE

CONTRACTOR and Owner recognize that time is of the essence and that Owner may suffer financial loss if the Work is not completed within the times specified in paragraph above, plus any extensions thereof allowed in accordance with an executed change order. The parties also recognize the delays, expenses and difficulties involved in proving the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty), CONTRACTOR shall pay Owner $250 for each day that expires after the time specified for Substantial Completion until the Work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the time specified for completion and readiness for final payment or any proper extension thereof granted by Owner, CONTRACTOR shall pay Owner $500 for each day that expires after the time specified for final completion.

I (we) agree to accept payment on mutually agreed upon quantities and the unit prices listed in the attached bid form. All bills will be compiled and submitted through the last day of each month. Said payment will be made on 95% of the labor performed during each billing period. Remaining 5% will be released upon final completion of the project and after receipt of a notarized waiver of lien, as required.

To the maximum extent allowed by law, we agree to indemnify, hold harmless and defend The Maine Water Company, its officers, employees and agents from and against any and all liability for loss, damage or expense which The Maine Water Company, its officers, employees and agents may suffer or for which The Maine Water Company, its officers, employees and agents may be held liable by reason of injury (including death) to any person or damage to any property arising out of or in any manner connected with the operations to be performed under this contract, and to the maximum extent allowed by law, the CONTRACTOR shall also indemnify and save harmless The Maine Water Company, its officers, employees and agents from all claims with respect to injuries to employees of the CONTRACTOR or of any subcontractor or other employer performing work in connection with the operations to be performed under this contract; provided however the foregoing indemnity shall not extend to a case involving liability for damage arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of The Maine Water Company.

Identify designated primary Competent Person and an alternate responsible for site and trench safety on this project. This individual(s) is to be on site to address all safety matters.

Primary:_____ Phone:_____

Alternate:_____ Phone:_____

AGREEMENT

WATER MAIN REPLACEMENT CROSSING UNDER MAINE TURNPIKE IN SACO

STATE ROUTE 112 & MAINE TURNPIKE

Contractor Name: _____

Address:_____

Telephone:_____

Cell Phone: _____

E-Mail: _____

_____ Date _____
Authorized Signature
Print Name: _____

Title: _____

Witness Signature:_____Print Name:_____

Witness Signature:_____Print Name:_____

Maine Water Company:

_____ Date _____
Authorized Signature

Print Name: _____

Title: _____

Witness Signature:_____Print Name:_____

Witness Signature:_____Print Name:_____

SECTION V
Notice of Award

Dated:

Project:	Owner : **Maine Water Company**	Owner's Contract No.:
Contract:		Engineer's Project No.:
Bidder:		
Bidder's Address: (send Certified Mail, Return Receipt Requested)		

You are notified that your Bid dated ____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract.

The Contract Price of your Contract is attached.

You must comply with the following conditions precedent within 10 days of the date you receive this Notice of Award.

1. Deliver to the Owner 2 copies of insurance certificate.
2. Deliver with the executed Contract Documents the AGREEMENT
3. Other conditions precedent:

_____

_____

_____

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award and declare your Bid forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

Maine Water Company
Owner

By: _____
Authorized Signature

Engineer
Title

SECTION VI

Notice to Proceed

Dated:

Project:	Owner: Maine Water Company	Owner's Contract No.:
Contract:		Engineer's Project No.:

CONTRACTOR:

CONTRACTOR's Address: [send Certified Mail, Return Receipt Requested]

You are notified that the Contract Times under the above contract will commence to run on ___. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is _____ [(or) the number of days to achieve Substantial Completion is, and the number of days to achieve readiness for final payment is_____.

Before you may start any Work at the Site you must deliver the certificates of insurance which is required to be purchased and maintained in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must [add other requirements]:

_____

_____

_____

	Maine Water Company
CONTRACTOR	Owner
Received by:	Given by:
	Authorized Signature
	Engineer
Title	Title
Date	Date

SECTION VII

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner: **Maine Water Company**	Owner's Contract No.:
Contract:		Date of Contract:
CONTRACTOR:		Engineer's Project No.:

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments: (List documents supporting change):

Project

CHANGE IN CONTRACT PRICE:

Original Contract Price:

$_____

[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:

$_____

Contract Price prior to this Change Order:

$_____

[Increase] [Decrease] of this Change Order:

$_____

Contract Price incorporating this Change Order:

$_____

CHANGE IN CONTRACT TIMES:

Original Contract Times: ☐ Working days x Calendar days

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:

Substantial completion (days): _____

Ready for final payment (days): _____

Contract Times prior to this Change Order:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] of this Change Order:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

Contract Times with all approved Change Orders:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	CONTRACTOR (Authorized Signature)
Date: _____	Date: _____	Date: _____

SECTION VIII
Certificate of Substantial Completion

PROJECT _____

DATE OF ISSUANCE _____

OWNER _____Maine Water Company_____

OWNER'S Contract No. _____

CONTRACTOR _____

This certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

TO _____Maine Water Company_
(OWNER)

And To _____
(CONTRACTOR)

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER and CONTRACTOR, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

_____
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within ____ days of the above date of Substantial Completion.

SECTION IX
Field Note Requirement

Maine Water Company
Field Notes Requirements

The CONTRACTOR will be responsible for providing "As Built" information for the COMPANY's installation records in the form of high accuracy GPS points and physical as built measurements. The information below shall be provided to MWC upon completion of the project and should be provided in a neat and legible format.

As Built Drawings

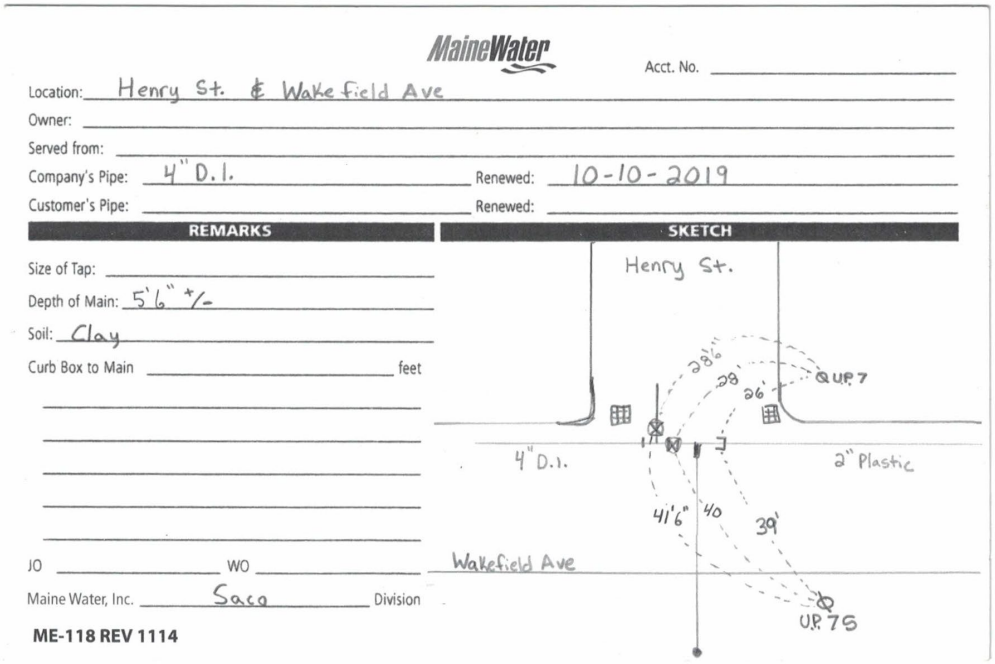
All project reference points shall each contain two swing ties, which may include but are not limited to, building corners, hydrants, utility poles, manhole covers, or other permanent structures. Examples are included on the following pages.

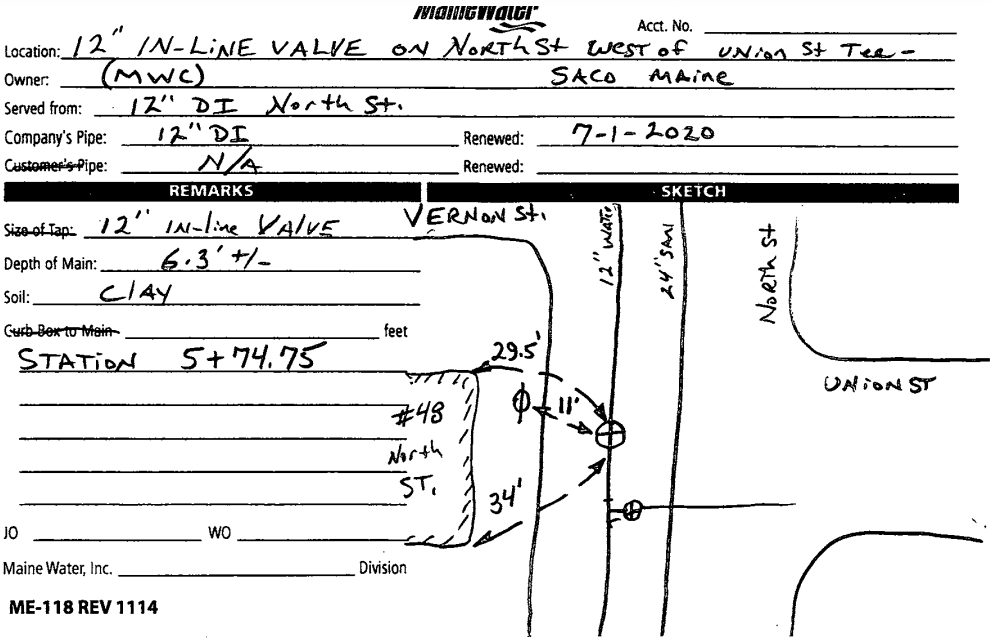
High Accuracy GPS Data

High accuracy GPS data collection points of all assets listed above. This data must be collected at accuracies <10 cm into a usable format for MWC. Acceptable formats include a shape file (.shp) projected in the NAD 1983 UTM 19N projection (EPSG Code: 26919). CAD drawing (.dwg) files will also be accepted as long as the file has been spatially referenced to the system mentioned above. The CONTRACTOR is responsible for working with MWC to obtain a working high accuracy GPS file. Examples are included on the following pages.

Mainline Valves and Fitting As Built Examples

- Measure and record swing-ties for each mainline valve and fitting
- Measure and record depth of valves and fittings
- Measure and record distances to other nearby valves and fittings
- Record valve and fitting size, type, and make (ex: “8-inch MJ gate valve”)
- Include water main(s), underground conflicts, and street names in drawings





Service and Blow off

Connections/Installation As Built Examples

- Measure and record swing-ties for all service line valves, corporations, and fittings
- Measure and record distance from curb box to corporation
- Measure and record depth of all service line valves, corporations, and fittings
- Include size and material of service lines
- Include water main(s), underground conflicts, and street names in drawings

MaineWater

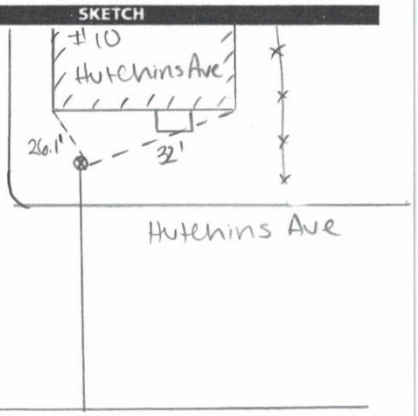
Location: #10 Hutchins Acct. No.

Owner:

Served from: 8" DI on Hutchins Ave

Company's Pipe: 1" Copper Renewed: 9-25-2019

Customer's Pipe: 3/4" Copper Renewed:

REMARKS	SKETCH
Size of Tap: 1"	
Depth of Main: 5'	
Soil: Mix of Clay/Sand with Cobbles	
Curb Box to Main 37' feet	
(curb to street line 0')	
Depth @ Privale 5.5'	

JO WO

Maine Water, Inc. Saco Division 8"

ME-118 REV 1114

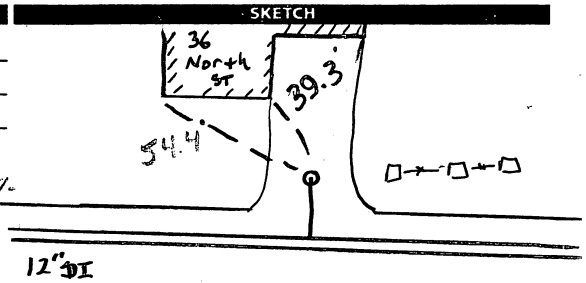
Location: 36 North St. SACO, MAINE 6-26-20 / 7-29-20

Owner:

Served from: 12" DI on North St.

Company's Pipe: 1" Copper Renewed: 7-24-20

Customer's Pipe: 3/4" Copper Renewed:

REMARKS	SKETCH
Size of Tap: 1"	
Depth of Main: 5.5' +/-	
Soil: CLAY	
Curb Box to Main 23.3 feet	
STOP to street line 2' +/-	
Depth at stop 4'	
STATION 4 +19	

JO WO

Maine Water, Inc. Division

NORTH St.

ME-118 REV 1114

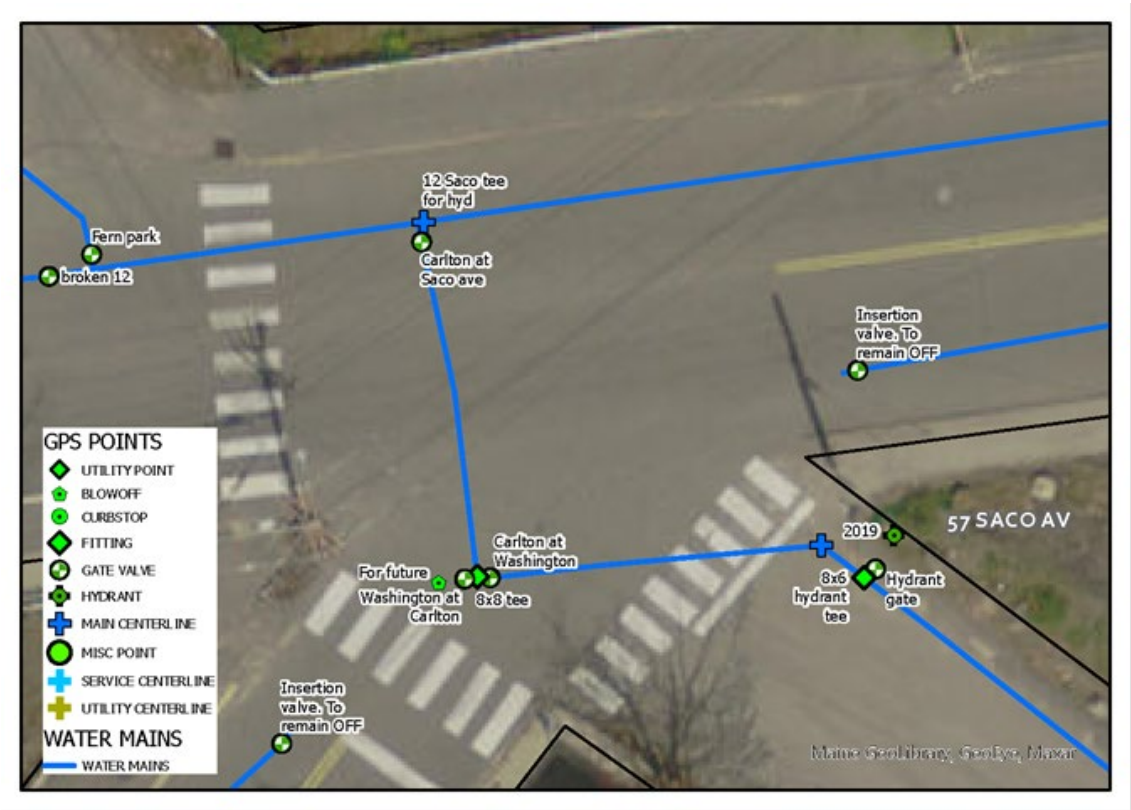
High Accuracy GPS Data

Examples

GPS points are needed for each of the following:

- Hydrants
- Gate valves and service valves
- Fittings (tees, bends, corporations, reducers, etc.)
- Blow off assemblies
- Water main centerline points every 40 feet
- Frequent water main centerline points
- Service line centerline points where the tap and curb box are not perpendicular
- Utility crossings such as sewer or storm drain

GPS points should include attributes referring to the assets they represent. For example, a service valve point with the address denoted as "*200 Main St domestic*" or a tee fitting with label denoted "*8x6 tee*". Water main centerline points should be taken every so often and include all fittings on the main such as service corporations or tees. See image below for examples.



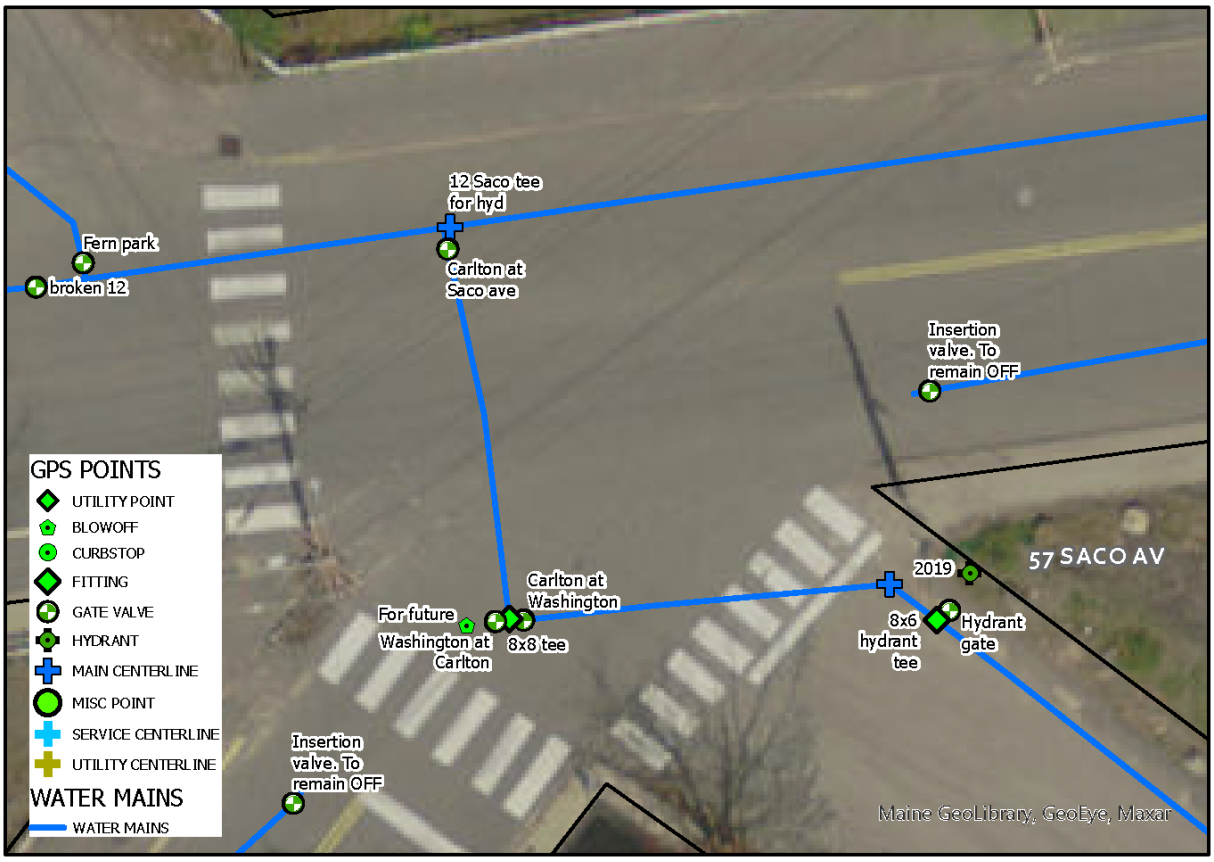
The CONTRACTOR will be responsible for providing "As Built" information for the COMPANY's installation records. The information below shall be provided to MWC upon completion of the project and should be provided in a neat and legible format.

Reference points for swing-tie measurements (choose two points of reference in this order)

- Two front corners of nearest building marked by address (if available)
- Nearest utility poles marked by pole numbers (if available)
- Nearest manhole covers and storm drains (if available)
- Other permanent structures if needed

Mainline Valves and Fittings

- Measure and record swing-ties for each mainline valve and fitting
- Measure and record depth of valves and fittings
- Measure and record distances to other nearby valves and fittings
- Record valve and fitting size, type, and make (ex: "8-inch MJ gate valve")
- Include water main(s), underground conflicts, and street names in drawings



Service and Blow off Connections/Installations

- Measure and record swing-ties for all service line valves, corporations, and fittings
- Measure and record distance from curbstop to corporation
- Measure and record depth of all service line valves, corporations, and fittings
- Include size and material of service lines
- Include water main(s), underground conflicts, and street names in drawings

SECTION X
Insurance Certificates

SECTION XI
Lien Waiver

SECTION XII

Details