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Letting July 31, 2020

Notice to Bidders, Specifications and Proposal

Contract No. 61G62
DUPAGE County
Section 16-00045-01-MS (Clarendon Hills)
Route MUN 1003 (Prospect Avenue)
Project 6LRR-035 ()
District 1 Construction Funds

Prepared by	F
Checked by	

(Printed by authority of the State of Illinois)

Illinois Department of Transportation

NOTICE TO BIDDERS

1. **TIME AND PLACE OF OPENING BIDS.** Electronic bids are to be submitted to the electronic bidding system (iCX-Integrated Contractors Exchange). All bids must be submitted to the iCX system prior to 12:00 p.m. July 31, 2020 at which time the bids will be publicly opened from the iCX SecureVault.

2. **DESCRIPTION OF WORK**. The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

   Contract No. 61G62
   DUPAGE County
   Section 16-00045-01-MS (Clarendon Hills)
   Project 6LRR-035 ()
   Route MUN 1003 (Prospect Avenue)
   District 1 Construction Funds

Resurfacing, sidewalks, landscaping and contruction of a train platform shelter on Prospect Avenue, from Burlington Avenue to Ann Street in Clarendon Hills.

3. **INSTRUCTIONS TO BIDDERS**. (a) This Notice, the invitation for bids, proposal and letter of award shall, together with all other documents in accordance with Article 101.09 of the Standard Specifications for Road and Bridge Construction, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

   (b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.

4. **AWARD CRITERIA AND REJECTION OF BIDS**. This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the rules, Invitation for Bids and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to re-advertise the proposed improvement, and to waive technicalities.

By Order of the
Illinois Department of Transportation

Omer Osman,
Acting Secretary

CONTRACT 61G62

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2020

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS, frequently used RECURRING SPECIAL PROVISIONS, and LOCAL ROADS AND STREETS RECURRING SPECIAL PROVISIONS.

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 4-1-16) (Revised 1-1-20)

SUPPLEMENTAL SPECIFICATIONS

RECURRING SPECIAL PROVISIONS

The following RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

LOCAL ROADS AND STREETS RECURRING SPECIAL PROVISIONS

The following LOCAL ROADS AND STREETS RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

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BDE SPECIAL PROVISIONS

The following special provisions indicated by an "X" are applicable to this contract. An * indicates a new or revised special provision for the letting.

File Name	Pg.		Special Provision Title	Effective	Revised
80099			Accessible Pedestrian Signals (APS)	April 1, 2003	April 1, 2020
80274			Aggregate Subgrade Improvement	April 1, 2012	April 1, 2016
80192			Automated Flagger Assistance Device	Jan. 1, 2008	
80173			Bituminous Materials Cost Adjustments	Nov. 2, 2006	Aug. 1, 2017
80246			Bituminous Surface Treatment with Fog Seal	Jan. 1, 2020	
80241			Bridge Demolition Debris	July 1, 2009	
5026I			Building Removal-Case I (Non-Friable and Friable Asbestos)	Sept. 1, 1990	April 1, 2010
5048I			Building Removal-Case II (Non-Friable Asbestos)	Sept. 1, 1990	April 1, 2010
5049I			Building Removal-Case III (Friable Asbestos)	Sept. 1, 1990	April 1, 2010
5053I	617	X	Building Removal-Case IV (No Asbestos)	Sept. 1, 1990	April 1, 2010
80425			Cape Seal	Jan. 1, 2020	
80384	619	X	Compensable Delay Costs	June 2, 2017	April 1, 2019
80198			Completion Date (via calendar days)	April 1, 2008	
80199			Completion Date (via calendar days) Plus Working Days	April 1, 2008	
80293			Concrete Box Culverts with Skews > 30 Degrees and Design Fills ≤ 5 Feet	April 1, 2012	July 1, 2016
80311			Concrete End Sections for Pipe Culverts	Jan. 1, 2013	April 1, 2016
80277			Concrete Mix Design – Department Provided	Jan. 1, 2012	April 1, 2016
80261	623	X	Construction Air Quality – Diesel Retrofit	June 1, 2010	Nov. 1, 2014
80387			Contrast Preformed Plastic Pavement Marking	Nov. 1, 2017	
80029	626	X	Disadvantaged Business Enterprise Participation	Sept. 1, 2000	Mar. 2, 2019
80402	636	X	Disposal Fees	Nov. 1, 2018	
80378			Dowel Bar Inserter	Jan. 1, 2017	Jan. 1, 2018
80405			Elastomeric Bearings	Jan. 1, 2019	
80421			Electric Service Installation	Jan. 1, 2020	
80415	638	X	Emulsified Asphalts	Aug. 1, 2019	
80423	641	X	Engineer's Field Office Laboratory	Jan. 1, 2020	
80388	644	X	Equipment Parking and Storage	Nov. 1, 2017	
80229			Fuel Cost Adjustment	April 1, 2009	Aug. 1, 2017
80417	645	X	Geotechnical Fabric for Pipe Underdrains and French Drains	Nov. 1, 2019	
80420			Geotextile Retaining Walls	Nov. 1, 2019	
80304			Grooving for Recessed Pavement Markings	Nov. 1, 2012	Nov. 1, 2017
80422			High Tension Cable Median Barrier Reflectors	Jan. 1, 2020	
80416			Hot-Mix Asphalt – Binder and Surface Course	July 2, 2019	Nov. 1, 2019
80398			Hot-Mix Asphalt – Longitudinal Joint Sealant	Aug. 1, 2018	Nov. 1, 2019
80406			Hot-Mix Asphalt – Mixture Design Verification and Production (Modified for I-FIT Data Collection)	Jan. 1, 2019	Jan. 2, 2020
80347			Hot-Mix Asphalt – Pay for Performance Using Percent Within Limits – Jobsite Sampling	Nov. 1, 2014	July 2, 2019
80383			Hot-Mix Asphalt – Quality Control for Performance	April 1, 2017	July 2, 2019
80411			Luminaires, LED	April 1, 2019	
80393	647	X	Manholes, Valve Vaults, and Flat Slab Tops	Jan. 1, 2018	Mar. 1, 2019
80045			Material Transfer Device	June 15, 1999	Aug. 1, 2014
80418			Mechanically Stabilized Earth Retaining Walls	Nov. 1, 2019	
80424			Micro-Surfacing and Slurry Sealing	Jan. 1, 2020	
80428	649	X	Mobilization	April 1, 2020	
80165			Moisture Cured Urethane Paint System	Nov. 1, 2006	Jan. 1, 2010
80412			Obstruction Warning Luminaires, LED	Aug. 1, 2019	
80349			Pavement Marking Blackout Tape	Nov. 1, 2014	April 1, 2016
80371	650	X	Pavement Marking Removal	July 1, 2016	
80389	651	X	Portland Cement Concrete	Nov. 1, 2017	

	File Name	Pg.		Special Provision Title	Effective	Revised
*	80430	652	X	Portland Cement Concrete – Haul Time	July 1, 2020	
	80359			Portland Cement Concrete Bridge Deck Curing	April 1, 2015	Nov. 1, 2019
*	80431			Portland Cement Concrete Pavement Patching	July 1, 2020	
*	80432			Portland Cement Concrete Pavement Placement	July 1, 2020	
	80300			Preformed Plastic Pavement Marking Type D - Inlaid	April 1, 2012	April 1, 2016
	3426I			Railroad Protective Liability Insurance	Dec. 1, 1986	Jan. 1, 2006
	80157	653	X	Railroad Protective Liability Insurance (5 and 10)	Jan. 1, 2006	
	80306			Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS)	Nov. 1, 2012	Jan. 2, 2020
	80407	655	X	Removal and Disposal of Regulated Substances	Jan. 1, 2019	Jan. 1, 2020
	80419	666	X	Silt Fence, Inlet Filters, Ground Stabilization and Riprap Filter Fabric	Nov. 1, 2019	April 1, 2020
	80395			Sloped Metal End Section for Pipe Culverts	Jan. 1, 2018	
	80340			Speed Display Trailer	April 2, 2014	Jan. 1, 2017
	80127			Steel Cost Adjustment	April 2, 2014	Aug. 1, 2017
	80408			Steel Plate Beam Guardrail Manufacturing	Jan. 1, 2019	
	80413			Structural Timber	Aug. 1, 2019	
	80397	672	X	Subcontractor and DBE Payment Reporting	April 2, 2018	
	80391	673	X	Subcontractor Mobilization Payments	Nov. 2, 2017	April 1, 2019
	80317			Surface Testing of Hot-Mix Asphalt Overlays	Jan. 1, 2013	Aug. 1, 2019
	80298	674	X	Temporary Pavement Marking	April 1, 2012	April 1, 2017
	80403			Traffic Barrier Terminal, Type 1 Special	Nov. 1, 2018	
	80409	677	X	Traffic Control Devices – Cones	Jan. 1, 2019	
	80410			Traffic Spotters	Jan. 1, 2019	
	20338			Training Special Provisions	Oct. 15, 1975	
	80318			Traversable Pipe Grate for Concrete End Sections	Jan. 1, 2013	Jan. 1, 2018
	80429			Ultra-Thin Bonded Wearing Course	April 1, 2020	
	80288	678	X	Warm Mix Asphalt	Jan. 1, 2012	April 1, 2016
	80302	680	X	Weekly DBE Trucking Reports	June 2, 2012	April 2, 2015
	80414			Wood Fence Sight Screen	Aug. 1, 2019	April 1, 2020
	80427	681	X	Work Zone Traffic Control Devices	Mar. 2, 2020	
	80071	683	X	Working Days	Jan. 1, 2002	

The following special provisions are in the 2020 Supplemental Specifications and Recurring Special Provisions.

File Name	Special Provision Title	New Location(s)	Effective	Revised
80404	Coarse Aggregate Quality for Micro-Surfacing and Cape Seals	Article 1004.01(b)	Jan. 1, 2019	
80392	Lights on Barricades	Articles 701.16, 701.17(c)(2) & 603.07	Jan. 1, 2018	
80336	Longitudinal Joint and Crack Patching	Check Sheet #36	April 1, 2014	April 1, 2016
80400	Mast Arm Assembly and Pole	Article 1077.03(b)	Aug. 1, 2018	
80394	Metal Flared End Section for Pipe Culverts	Articles 542.07(c) and 542.11	Jan. 1, 2018	April 1, 2018
80390	Payments to Subcontractors	Article 109.11	Nov. 2, 2017	

The following special provisions have been deleted from use.

File Name	Special Provision Title	Effective	Revised
80328	Progress Payments	Nov. 2, 2013	

STATE OF ILLINOIS

SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction" adopted April 1st, 2016 (hereinafter referred to as the Standard Specifications); the latest edition of the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways" in effect on the date of invitation for bids; and the "Supplemental Specifications and Recurring Special Provisions" indicated on the check sheet provided herein, all of which apply to and govern the construction of

Prospect Avenue
Ann Street to Burlington Avenue
Section: 16-00045-01-MS
Project No.: 6LRR(035)
Job No.: C-91-040-22
Contract No.: 61G62
DuPage County

In case of conflict with any part or parts of said documents, these Special Provisions shall take precedence and shall govern.

LOCATION OF PROJECT

The improvement is located in the Village of Clarendon Hills, DuPage County. The Project starts just south of the Prospect/Railroad/Ann Street intersection proceeds north to a point just south of Burlington Avenue. The total gross and net length of the improvement is 198.5 feet (0.04 miles).

DESCRIPTION OF PROJECT

The work consists of pavement resurfacing, pavement patching, curb and gutter, drainage structures, storm sewer, sidewalk, ADA ramps, pavement markings, streetscape elements, landscaping, other streetscape elements, the removal of the existing north train platform shelter, and construction of a new shelter along with all incidental and collateral work necessary to complete the project as shown on the plans and as described herein.

CONTRACTOR COOPERATION

It is anticipated that this contract will be constructed concurrently with other projects in the same area. The projects that may be under contract concurrent with this project is as follows:

Metra Station Improvement Project
Contact – Dan Ungerleider, Village of Clarendon Hills
Prospect Avenue Railroad Crossing Improvement
Contact – Dan Peltier, BNSF Railroad

The Contractor shall schedule their work in order to minimize any conflicts that may arise between contracts as specified in Article 105.08 of the Standard Specifications. No additional compensation will be allowed for delays or inconveniences resulting from activities of other contractors.

REMOVAL OF MISCELLANEOUS ITEMS

The Contractor shall, with the approval of the Engineering, remove and dispose of existing fences, gates, signs (except traffic signs) concrete, brush or other miscellaneous items which may interfere with the proposed construction, and are not paid for separately. These items shall be removed and disposed of outside the limits of the right-of-way at locations provided by the Contractor, and this work shall be considered as included in the cost of Earth Excavation.

Any existing features and appurtenances that are to remain and are damaged or removed by the Contractor shall be repaired or replaced by the Contractor at his/her expense.

REMOVAL OF EXISTING PAVEMENT AND APPURTENANCES

When portions of existing pavements or appurtenances are to remain in place, or adjacent existing pavements or appurtenances are to remain in place, the Contractor shall form a perpendicular straight joint by full-depth machine sawing at the ends and all edges of portions to be removed to prevent surface spalling when the existing pavement or appurtenance is removed. Any damage to the existing pavement or appurtenance to remain in place shall be repaired or removed and replaced by the Contractor at his/her own expense, as directed by the Engineer. This work will not be measured or paid for separately, but shall be considered included in the item being removed.

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES

Description. This work shall consist of the removal and disposal of regulated substances according to Section 669 of the Standard Specifications as revised below.

Contract Specific Sites. The excavated soil and groundwater within the areas listed below shall be managed as either “uncontaminated soil”, hazardous waste, special waste or non-special waste. For stationing, the lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit, whichever is less.

Intersection Prospect Avenue and Railroad Avenue

- All excavation planned at the southwest quadrant of the intersection of Prospect Avenue and Railroad Avenue, Clarendon Hills, Illinois. This material meets the criteria of Article 669.05(a)(5) and shall be managed in accordance to Article 669.05. Potential contaminants of concern sampling parameters: Benzene.

Work Zones. Three distinct OSHA HAZWOPER work zones (exclusion, decontamination, and support) shall apply to projects adjacent to or within sites with documented leaking underground storage tank (LUST) incidents, or sites under management in accordance with the requirements of the Site Remediation Program (SRP), Resource Conservation and Recovery Act (RCRA), or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or as deemed necessary. For this project, the work zones apply for the following ISGS PESA Sites: None.

Additional information on the above sites is available from the Village of Clarendon Hills.

PROTECTION OF EXISTING TREES

The Contractor shall be responsible for taking measures to minimize damage to the tree limbs, tree trunks, and tree roots at each work site. All such measures shall be included in the contract price for other work except that payment will be made for TEMPORARY FENCE and TREE ROOT PRUNING.

All work, materials and equipment shall conform to Section 201 and 1081 of the Standard Specifications except as modified herein.

A. Tree Trimming:

1. All tree branches that are less than 12 feet above the surface of the trail shall be removed by the Contractor. The Contractor shall perform the work in accordance with Article 201.05(c) for woody plant maintenance, tree care operations pruning, trimming, repairing, maintaining and removing trees and cutting brush. This work shall be included in the cost of mobilization and will not be paid for as separate items.

B. Earth Saw Cut of Tree Roots (Root Pruning):

1. Whenever proposed excavation falls within a drip-line of a tree, the Contractor shall:

   a. Root prune 6-inches behind and parallel to the proposed edge of trench a neat, clean vertical cut to a minimum depth directed by the Engineer through all affected tree roots.

   b. Root prune to a maximum width of 4-inches using a “Vermeer” wheel, or other similar machine. Trenching machines will not be permitted.

   c. Exercise care not to cut any existing utilities.

d. If during construction it becomes necessary to expose tree roots which have not been precut, the Engineer shall be notified and the Contractor shall provide a clean, vertical cut at the proper root location, nearer the tree trunk, as necessary, by means of hand-digging and trimming with chain saw or hand saw. Ripping, shredding, shearing, chopping or tearing will not be permitted.

e. Top Pruning: When thirty percent (30%) or more of the root zone is pruned, an equivalent amount of the top vegetative growth or the plant material shall be pruned off within one (1) week following root pruning.

2. Whenever curb and gutter is removed for replacement, or excavation for removal of or construction of a structure is within the drip line/root zone of a tree, the Contractor shall:

a. Root prune 6-inches behind the curbing so as to neatly cut the tree roots.

b. Depth of cut shall be 12 inches for curb removal and replacement and 24 inches for structural work. Any roots encountered at a greater depth shall be neatly saw cut at no additional cost.

c. Locations where earth saw cutting of tree roots is required will be marked in the field by the Engineer.

3. All root pruning work is to be performed through the services of a licensed arborist to be approved by the Engineer.

Root pruning will be paid for at the contract unit price each for TREE ROOT PRUNING, which price shall be payment for all labor, materials and equipment.

Tree limb pruning will be paid for at the contract unit price per each for TREE PRUNING (1 TO 10 INCH DIAMETER) and/or TREE PRUNING (OVER 10 INCH DIAMETER), price shall include labor, materials, and equipment.

C. Temporary Fence:

1. The Contractor shall erect a temporary fence around all trees within the construction area to establish a “tree protection zone” before any work begins or any material is delivered to the jobsite. No work is to be performed (other than root pruning), materials stored or vehicles driven or parked within the “tree protection zone”.

2. The exact location and establishment of the “tree protection zone” fence shall be approved by the Engineer prior to setting the fence.

3. The fence shall be erected on three sides of the tree at the drip-line of the tree or as determined by the Engineer.

4. All work within the “tree protection zone” shall have the Engineer’s prior approval. All slopes and other areas not regarded should be avoided so that

unnecessary damage is not done to the existing turf, tree root system ground cover.

5. The grade within the "tree protection zone" shall not be changed unless approved by the Engineer prior to making said changes or performing the work.

The fence shall be similar to wood lath snow fence (48 inches high), plastic poly-type or and other type of highly visible barrier approved by the Engineer. This fence shall be properly maintained and shall remain up until final restoration, unless the Engineer directs removal otherwise. Tree fence shall be supported using T-Post style fence posts. **Utilizing re-bar as a fence post will not be permitted.**

Temporary fence will be paid for at the contract unit price per foot for TEMPORARY FENCE, which price shall include furnishing, installing, maintaining, and removing.

D. Tree Limb Pruning:

1. The Contractor shall inspect the work site in advance and arrange with the Roadside Development Unit (847.705.4171) to have any tree limbs pruned that might be damaged by equipment operations at least one week prior to the start of construction. Any tree limbs that are broken by construction equipment after the initial pruning must be pruned correctly within 72 hours.

2. Top Pruning: When thirty percent (30%) or more of the root zone of a tree is pruned, an equivalent amount of the top vegetative growth or the plant material shall be pruned off within one (1) week following root pruning.

Tree limb pruning will be paid for at the contract unit price per each for TREE PRUNING (1 TO 10 INCH DIAMETER) and/or TREE PRUNING (OVER 10 INCH DIAMETER), price shall include labor, materials, and equipment.

E. Removal of Driveway Pavement and Sidewalk:

1. In order to minimize the potential damage to the tree root system(s), the Contractor will not be allowed to operate any construction equipment or machinery within the "tree protection zone" located between the curb or edge of pavement and the right-of-way property line.

2. Sidewalk to be removed in the areas adjacent to the "tree protection zones" shall be removed with equipment operated from the street pavement. Removal equipment shall be Gradall (or similar method), or by hand or a combination of these methods. The method of removal shall be approved by the Engineer prior to commencing any work.

3. Any pavement or pavement related work that is removed shall be immediately disposed of from the area and shall not be stockpiled or stored within the parkway area under any circumstances.

F. Backfilling:

1. Prior to placing the topsoil and/or sod, in areas outside the protection zone, the existing ground shall be disked to a depth no greater than one (1"), unless otherwise directed by the Engineer. No grading will be allowed within the drip-line of any tree unless directed by the Engineer.

G. Damages:

1. In the event that a tree not scheduled for removal is injured such that potential irreparable damage may ensure, as determined by the Roadside Development Unit, the Contractor shall be required to remove the damage tree and replace it on a three to one (3:1) basis, at his own expense. The Roadside Development Unit will select replacement trees from the pay items already established in the contract.

2. The Contractor shall place extreme importance upon the protection and care of trees and shrubs which are to remain during all times of this improvement. It is of paramount importance that the trees and shrubs which are to remain are adequately protected by the Contractor and made safe from harm and potential damage from the operations and construction of this improvement. If the Contractor is found to be in violation of storage or operations within the "tree protection zone" or construction activities not approved by the Engineer, a penalty shall be levied against the Contractor with the monies being deducted from the contract. The amount of the penalty shall be two hundred fifty dollars ($250.00) per occurrence per day.

PAVEMENT IMPRINTING

Description: This work shall consist of the layout and imprinting of a crosswalk pattern, as shown on the details, into the street surface course using TrafficPatterns XD an imprinted aggregate reinforced performed thermoplastic pavement marking system.

Construction Requirements: The product shall be installed per the latest revision of the manufacturer's application procedures. The project specifications and procedures shall be an imprinted aggregate reinforced preformed thermoplastic pavement marking system TrafficPatterns XD.

The color shall be 'Santa Fe' and the pattern shall be herringbone with a soldier bond course. The white lines on the outside of the crosswalk shall be a preformed thermoplastic material.

Method of Measurement: This work will be measured for payment in place and the area calculated in square yards.

Basis of Payment: This work will be measured for payment at the contract unit price per square yard for PAVEMENT IMPRINTING, complete and in place, which price shall include all costs to furnish, transport, and place all materials required including all specified preformed thermoplastic.

EROSION CONTROL BLANKET

Description: Work shall be performed in accordance with Section 251 of the Standard Specifications for Road and Bridge Construction and subsequent special provisions.

Contractor will be required to install erosion control blanket in the areas receiving 'Wetland Type Perennial Plants'. The erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 18 months. The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a 100% biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands to form an approximate 0.50 x 1.0 in. (1.27 x 2.54 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

Location: Blanket is only required where 'Perennial Plants, Wetland Type' are being installed. Refer to contract drawings for locations.

Method of Measurement: EROSION CONTROL BLANKET will be measured per square yard.

Basis of Payment: EROSION CONTROL BLANKET will be paid for at the contract unit price per square yard. This shall include all labor, materials, equipment and incidentals for all work involved installing the erosion control blanket.

BENCH REMOVAL

This item consists of the removal and disposal of existing benches from the locations shown in the plans. The bench and any connecting hardware to the foundation or sidewalk including bolts shall be removed in their entirety. Holes or excavations resulting from the removal operation shall be backfilled with suitable material and compacted to the satisfaction of the Engineer.

BENCH REMOVAL, shall be measured per each, and shall be paid for at the contract unit price per each, measured as specified, which payment shall constitute full compensation for removal and disposal of existing benches and accessories, including hardware; backfilling and compacting the resulting holes or excavations; and furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work as specified. Removal of the underlying sidewalk or concrete pad shall be paid for as SIDEWALK REMOVAL.

TRENCH DRAIN

Description: This work shall consist of the preparation; excavation; furnishing and installation of the sidewalk trench drain including concrete channel, reinforcement, trench grate and frame, and other appurtenances, as required by the plans and specifications.

Materials: Materials shall be according to the following.

Portland Cement Concrete shall be class SI per Section 1020 of the Standard Specifications.

Preformed expansion joint fillers shall be per Section 1051 of the Standard Specifications.

Trench Grate shall be cast iron meeting ASTM A48 Class 35B, AASHTO M105 Class 35B, AASHTO M306, and the Illinois Accessibility Code.

All trench grates and frames shall have text permanently cast onto the product. Frames and covers shall have the approved foundry's name, part number, country of origin, and production date for tracking purposes.

Castings shall be uniform quality, free from sand holes, gas holes, shrinkage, cracks, and other surface defects. Castings shall be ground smooth and well cleaned by shot blasting. As- cast dimensions may vary within accepted foundry tolerances as outlined in the Iron Casting Handbook published by the American Foundry Society, Inc. Nominally, casting dimensional tolerances shall be +/- 1/16" per foot. Castings shall be provided without coatings, unless otherwise specified.

Proof load testing shall be in accordance with AASHTO M 306. Castings shall have a minimum load rating of light duty (2,500-16,000 lbs).

Open area shall be a minimum of 64 square inches.

Refer to plans for frame and other requirements.

Basis of Payment: This work will be paid for at the contract unit price per each for TRENCH DRAIN.

RELOCATE BIKE FIX-IT STATION

This item consists of relocating an existing bicycle fix-it station at the location shown in the plans. The Contractor shall remove and store the station at a secure location and shall prevent any damage to it during its removal, storage, and reassembly. New bolts and connecting hardware, matching the existing hardware, shall be utilized in the reattachment of the station to the concrete pad or sidewalk at its new location. Any damages to the fix-it station during removal, storage, and/or relocation shall be repaired or replaced by the Contractor at his expense. Holes or excavations resulting from the removal operation shall be backfilled with suitable material and compacted to the satisfaction of the Engineer.

RELOCATE BIKE FIX-IT STATION shall be measured per each, and shall be paid for at the contract unit price per each, measured as specified, which payment shall constitute full compensation for removing and relocating the station and accessories; and furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work as specified. Removal of the underlying sidewalk or concrete pad shall be paid for as SIDEWALK REMOVAL.

BIKE RACK REMOVAL

This item consists of the removal and disposal of existing bike racks from the locations shown in the plans. The racks and any connecting hardware to the foundation or sidewalk including bolts shall be removed in their entirety. Holes or excavations resulting from the removal operation shall be backfilled with suitable material and compacted to the satisfaction of the Engineer.

BIKE RACK REMOVAL, shall be measured per each, and shall be paid for at the contract unit price per each, measured as specified, which payment shall constitute full compensation for removal and disposal of existing bike racks and accessories, including hardware; backfilling and compacting the resulting holes or excavations; and furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work as specified. Removal of the underlying sidewalk or concrete pad shall be paid for as SIDEWALK REMOVAL

GRASS PAVERS

Description: This work shall consist of providing and installing turf block paving as indicated on the Plans and as specified herein. This work includes supplying and placing interlocking turf block paving units as indicated on the Plans. Topsoil and seeding work will then be performed over the installed turf block in conformance with Article 250 of the Standard Specifications.

General: The Contractor shall submit manufacturer's product data, installation instructions, and two full size turf block samples for review. Reviewed and accepted samples will be returned to the Contractor and may be used in the work.

Turf block paving units shall be interlocking molded, lightweight, high strength, reinforced plastic paving blocks that permit natural turf to grow through unit voids. The paving units shall be as recommended by the manufacturer for support of AASHTO H20 vehicular traffic and shall meet or exceed manufacturer's field loading test requirements, without unit breakage or permanent deflection.

Turf block paving units shall be installed in accordance with the manufacturer's recommended installation details. Units shall be placed in a running bond pattern perpendicular to vehicular movement. Paving units shall be cut with motor driven saw equipment designed to cut plastic material with clean, sharp unchipped edges. Cut units as required to provide the pattern shown and to fit adjoining work neatly. Full units without cutting shall be used wherever possible. Where cutting is required, the largest size unit possible shall be used. The use of small pieces of pavers or large joint spaces shall be avoided. Gaps at the edge of the paved surface shall be filled with standard edge pieces or with paver units cut to fit. Only cut units with straight even cut surfaces shall be used. Installed turf block paver units shall be rolled with a standard lawn roller to their final level. After final rolling the surface shall be true to grade and shall not vary by more than ¼ inch when tested with a 10-foot straight-edge at any location on the surface. Voids surrounding the installed turf blocks shall be completely filled with topsoil and shall be sown with grass seed meeting the requirements of Seeding, Class 2A and in conformance with the applicable sections of Article 250 of the Standard Specifications.

Method of Measurement and Payment: This work will be measured and paid for at the contract unit price per square yard for GRASS PAVERS which shall be payment in full for all topsoil,

seed, materials, equipment, tools, labor, and accessories necessary to complete this item of work.

PIPE UNDERDRAINS (SPECIAL)

Material: Pipe material shall be per Section 1040.03 (b) of the Standard Specifications except as noted below.

All PVC sewer pipes and fittings shall have a minimum acceptable Standard Dimension Ratio (SDR) or Dimension Ratio (DR) of 26. The pipe shall be made of PVC plastic, having a minimum cell classification of 12454 per ASTM D 1784, and shall have a minimum pipe stiffness of forty-six (46) lbs. per inch.

Gravity sewer pipe and fittings having diameters 6" to 15" shall be in accordance with ASTM D 3034. The joints shall be solvent cemented joints per ASTM D 2855 or flexible elastomeric seals per ASTM D3212 and F 477.

Provide four rows of perforations meeting AASHTO M278 specifications.

Method of Measurement: PIPE UNDERDRAINS (SPECIAL) will be measured on a linear foot basis horizontally from end to end in accordance with Section 31-2 of the Standard Specifications for Sewer and Water construction in Illinois. The riser portion of pipe laterals from catch basins will be measured along the horizontal length of the sewer. Fittings for laterals will not be measured separately.

Basis of Payment: This work will be paid for at the contract unit price per foot for PIPE UNDERDRAINS (SPECIAL) of the diameter specified. The unit price shall include all labor, materials, equipment and cost necessary for excavation, installation of sewer pipe, backfilling and compaction necessary to complete this item.

CATCH BASIN (TYPE AND SIZE SPECIFIED)

Description: This item shall consist of furnishing and placing or constructing cast-in-place or precast concrete catch basins together with the necessary steps, frames, grates and lids as detailed in the plans at locations defined by the plan. The work shall include all labor, materials, equipment and cost necessary for excavation, installation of catch basins, backfilling and compaction necessary to complete this item.

Proposed invert elevations have been provided on the drawings. The Contractor shall be responsible for determining the size of precast flat top or cone section necessary to adjust the structure to final grade prior to beginning excavation for the structure.

Cast-in-place catch basins shall conform to detailed shop drawings submitted to the Engineer prior to the beginning of work and shall conform to the dimensional requirements specified. The materials, concrete mixture, curing process, compressive strength, and concrete base construction shall conform to Section 52-2 of the Standard Specifications for Water and Sewer Construction in Illinois.

Precast concrete catch basins, including the preformed flexible gaskets and mastic joint sealer, shall conform to Section 52-4 of the Standard Specifications for Water and Sewer Construction in Illinois.

Castings shall conform to the requirements of gray iron castings as specified in ASTM A 48. IDOT Type I frames shall be install for all catch basins. The placement of castings shall be according to Section 52-6.02 of the Standard Specifications for Water and Sewer Construction in Illinois.

A rubber boot connection conforming to ASTM C-923 shall be provided at all pipe connections to the catch basin as shown in the catch basin details.

Concrete adjusting rings shall conform to the requirements of Section 1043 of the latest edition of the IDOT Standard Specifications.

The backfill material shall be CA-6 and shall be installed in accordance with the Special Provision for TRENCH BACKFILL. The installation of backfill material shall be included in the unit price of the catch basin. All excavations shall be backfilled, whether by temporary or permanent means, by the end of each work day.

Connections from new sewers into the new catch basin structure shall be included in the cost of this item.

Basis of Payment: The furnishing and constructing of catch basins shall be per each CATCH BASIN of the type, diameter size, frame type, and lid type as specified.

BIORETENTION SYSTEM A

Description: This work shall consist of the preparation; dewatering; excavation; furnishing and installation of bioretention soil mix, coarse aggregate, geotextile; and the installation of perforated PVC pipe underdrain, as required by the plans and specifications.

Materials: Coarse aggregate shall be open-graded crushed stone, gradation CA-7, meeting the requirements of Article 1004 of the Standard Specifications, unless otherwise specified. Aggregates shall be sound crushed stone or crushed gravel. Gravel depths shall be per the Bioretention System detail included in the plans.

Bioretention soil mix shall consist of 50% sand (IDOT FA2), 30% planting soil with minimal clay content, and 20% shredded hardwood mulch per the DuPage County Best Management Practices Manual Practice Standard 3.2.2.2 Vegetated Swale. A minimum depth of 18” of bioretention soil mix shall be used in all bioretention areas.

Non-woven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1) Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2) Tear Strength: 40 lbf (178 N); ASTM D 4533.
3) Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4) Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.

5) Apparent Opening Size: No. 50 (0.3mm); ASTM D 4751.

Substitutions: Use only materials conforming to specifications unless permitted by Owner. Obtain approval from Owner prior to placing any material on site.

Execution: Bioretention areas shall be installed in all areas shown on the plans.

Excavation shall be performed in accordance with Section 202 of the IDOT Standard Specifications. Detailed grading and minimum and maximum slopes are shown in the plans and Bioretention System detail.

Do not allow water to accumulate in excavations. Remove water from excavations to prevent soil changes detrimental to the stability of subgrades. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from the site. Dewatering will not be paid for separately but shall be included in the cost of this work.

Protect bioretention areas from compaction by construction traffic and other construction activities. Stockpiling shall not be allowed in bioretention areas. Do not compact the native subgrade in bioretention areas.

Place geotextile fabric on subgrade as indicated. Place CA-7 aggregate base course in maximum 8-inch lifts. CA-7 aggregate base course shall be compacted according to AASHTO guidelines for installing open graded aggregates. CA-7 shall not be over-compacted, which may cause particle abrasion and introduction of fine material into base course. Place perforated underdrain in location and slope as indicated on the plans. Plans indicate general location and arrangement of underdrain sewer. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical. Place geotextile fabric between CA-7 and bioretention soil mix. Place bioretention soil mix. Lightly compact by wetting or rolling. Do not roll compact wet bioretention soil.

Install erosion control measures as shown on plans. Install landscape gravel as shown on landscape plan. Install bioretention planting material as shown on plans.

CA-7 aggregate or bioretention soil contaminated by construction site runoff, sediment, or other foreign materials shall be removed and replaced at no additional expense to the Owner. After placement of amended bioretention soil, bioretention areas shall be protected from construction traffic.

Method of Measurement: This work will be measured on a square foot basis.

Basis of Payment: This work will be paid for at the contract unit price per square foot for BIORETENTION SYSTEM A. All work associated with the bioretention system as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Pipe Underdrain shall be paid for separately. Planting material and landscape gravel shall be paid for separately. See landscape plans.

LIGHT POLE FOUNDATION (SPECIAL)

Description: This item shall consist of the preparation; excavation; furnishing and installation of new concrete light pole foundations, as required by the plans and specifications. The work consists of the installation of new foundations for pedestrian bollard lights and pedestrian light poles according to the details shown on the plans. The light poles and light bollards are to be supplied by the Village.

The Contractor shall verify the bolt pattern of the lighting fixtures and shall install the anchor rods based on the bolt pattern.

No foundation is to be poured until the Resident Engineer gives his/her approval as to the depth of the foundation.

Method of Measurement: LIGHT POLE FOUNDATION (SPECIAL) will be measured on an each basis.

Basis of Payment: This work will be paid for at the contract unit price per each for LIGHT POLE FOUNDATION (SPECIAL). The unit price shall include all labor, materials, equipment and cost necessary for excavation, reinforcing, anchor rods, installation of the foundations, backfilling and compaction, and all hardware necessary in preparation for the installation of the light fixtures.

The installation of the light fixtures will be paid for separately.

PEDESTRIAN LIGHT POLE, INSTALL ONLY

Description: This item shall consist of installing previously obtained pedestrian light poles and light bollards at the locations shown on the plans and according to Section 830 of the Standard Specifications. The light poles and light bollards are to be supplied by the Village.

The Contractor shall notify the Engineer 48 hours in advance of obtaining the fixtures. The Engineer and the Contractor shall inspect the fixtures prior to picking up the fixtures at the location designated by the Engineer. The Contractor shall load and deliver the fixtures from their stored location to the project site. The Contractor shall install the light fixture on a new foundation.

Method of Measurement: PEDESTRIAN LIGHT POLE, INSTALL ONLY will be measured on an each basis.

Basis of Payment: This work will be paid for at the contract unit price per each for PEDESTRIAN LIGHT POLE, INSTALL ONLY.

BICYCLE RACKS

Description: This work must consist of furnishing and installing new bicycle racks at the locations specified in the Contract plans or as directed by the Engineer.

General requirements:
Each bicycle rack will be placed at the location indicated in the plans. The locations will be field marked and verified for approval by the Engineer.

Materials: Materials must conform to the details below:

Style: Basis of design as shown on drawings
Finish: Powdercoated, manufacturer's standard silver color. Provide standard color swatches for final selection by Owner.
Size: Height and width as noted on drawings, 2" x 2" x ¼" square steel tubing.
Mounting. In-ground mount

Submittals:

Product data. Submit bicycle rack shop drawings or catalog cut.

Certifications. Submit manufacturer's certification that the tubing and coatings meet the project specifications. Prior to production, the manufacturer of the bicycle racks is to submit certification that the steel to be used follows the "Steel Products Procurement Act".

Installation: Bicycle Racks must be located according to the plans and as designated by the Engineer. Locations of racks to be verified in the field.

Method of Measurement: BICYCLE RACKS will be measured per each bike rack.

Basis of Payment: BICYCLE RACKS will be paid for at the contract unit price for each bicycle rack. This shall include all labor, materials, and equipment for all work involved. Cost of associated footings shall be considered part of the required materials.

PERENNIAL PLANTS

This work shall consist of furnishing and installing perennial plantings and as shown in the details on the plans and only at locations as directed by the Engineer.

Add the following to Article 254.02 Materials:

> All plants shall be healthy, vigorous, and true to species and variety. All materials shall be provided by a certified nursery and shall be free of pests and disease. All plant materials shall comply with State and federal laws with respect to inspection for plant diseases and infestations. Written approval shall be necessary for substitutions.
>
> Plants shall be obtained as close to possible to the project site. Written approval will be required for substitutions and plant material purchased outside a 200-mile radius of the site.

Delete Article 254.03(b) Planting Time and substitute the following:

> Plants shall only be planted between May 1 and June 15. Approval from the Engineer must be received for all planting dates.

Add the following to Article 254.04 Transporting and Storing Plants:

Each species should be handled and packed in the manner approved for the plant, having regard for the soil climatic conditions at the time and place of digging and delivery, and for the time that will be consumed for transit and delivery.

Plant materials shall be packed to ensure adequate protection against damage during transit. The plants shall be protected with wet material to ensure that the plant materials are delivered in a moist and cool condition. The vehicle should be ventilated to prevent overheating.

Plant materials shall be stored in a shaded area. Watering shall occur to maintain plant vigor during on-site storage.

An on-site inspection will be made prior to the installation of plant material. Any plant material not meeting specification (that being of good health) must be moved off the site.

Delete Article 254.05 Layout of Planting and substitute the following:

When plants are specified to be planted in prepared soil planting beds, the planting bed shall be approved by the Engineer prior to planting. Bed limits shall be painted or flagged. Individual plants layout shall be marked prior to installation. The Engineer will contact the Roadside Development Unit at (847) 705-4171 for layout.

Delete Article 254.06 (b) Planting Procedures and substitute the following:

When planting perennials in areas as shown on the plans or as directed by the Engineer, the following work shall be performed prior to planting:

- Trees and shrubs must be installed first to establish proper layout and to avoid damage to other plantings.

Install plants through erosion control blanket (wetland type plants only have blanket) with planting bar. Planting holes shall be as deep or slightly deeper than the plug roots to allow placing the plant without bending roots. Plant shall be placed flush with the earth surface. Hole shall be filled with soil carefully to avoid damage to roots and to leave no voids and pressed to firm earth surface.

Contractor shall provide and maintain all equipment necessary for planting, including watering equipment, water, and hoses. Immediately after planting, thoroughly water plant beds. Do not wash soil onto crowns of plants. The soil surface should be damp for the first three weeks following planting.

Delete Article 254.08 (b) Period of Establishment and substitute the following:

Plants must undergo a 30-day period of establishment. Additional watering shall be performed not less than three times a week for four weeks following installation. Water

shall be applied at the rate of at least 2 gallons per square foot. Should excess moisture prevail, the Engineer may delete any or all of the additional watering cycles. In severe weather, the Engineer may require additional watering.

A spray nozzle that does not damage small plants must be used when watering native plants. Water shall be applied at the base of the plant to keep as much water as possible off plant leaves. The plants to be watered and the method of application will be approved by the Engineer. The Contractor will not be relieved in any way from the responsibility for unsatisfactory plants due to the amount of watering.

Add the following to Article 254.09 Method of Measurement:

Disposal of debris (rock, stones, concrete, bottles, plastic bags, etc.) removed from the plug plantings as specified in Article 202.03.

Delete Article 253.17 Basis of Payment and substitute the following:

a) The unit price shall include the cost of all materials, equipment, labor, plant care, removal, disposal and incidentals required to complete the work as specified herein and to the satisfaction of the Engineer.

PERENNIAL PLANT CARE

Description: This work shall consist of weeding, replenishing mulch, trimming and other perennial plant care work items for each work cycle as described herein and as directed by the Engineer. The work required for each work cycle shall be scheduled to be complete and acceptable at the time of inspection.

Inspection Date: Perennial plant care will be inspected 5 days after the Engineer directs the Contractor to perform perennial plant care. The work required for each work cycle must be 100 percent complete on the inspection date. Partial inspections will not be made.

Work Cycle Requirements:

- Perennial plant beds must be 100 percent weed-free and clear of litter and debris to be acceptable. Control weeds in landscaped areas by pulling the entire plant and roots. (The Contractor may apply a pre-emergent herbicide, approved by the Engineer, during Spring perennial plant care cycles). Disturbed areas shall be raked level and mulch adjusted.
- Dead flowers, stems, and leaves must be trimmed and removed.
- Monitor mulch depths to maintain a two-inch (50 mm) depth around perennial plants (no more, no less). Rake mulch any away from perennial crowns.
- Finely shredded hardwood bark mulch must be replenished to maintain a two-inch (50 mm) depth around perennial plants, if necessary. Hardwood mulch shall not exceed two (2) inches in its largest dimension, free of foreign matter, sticks, stones and clods. (Mulch must be approved by the Engineer prior to placement).
- Remove litter and other debris. All drain inlets must be kept clean and draining freely. All walls, pavement, curb and gutters, and concrete pads are to be left clean and swept free of all debris.
- Plants must be free of insect infestations and sprayed if necessary.

- Beds must have a neatly spaded edge between the mulched bed and the turf.
- Mulch must be raked out of turf surrounding the mulched bed.
- All debris that results from this operation must be removed from the right-of-way and disposed of in accordance with Article 202.03 at the end of each day.
- Trim dead tips of vines and ground covers.
- In the spring (March/April), cut back ornamental grasses to six (6) inches in height. Cut down any perennial left up over the winter to a height of six (6) inches or less and remove any dead leaves around the crowns of the plants. Rake beds free of accumulated debris, dead leaves, and other material, leaving mulch in place and being careful not to damage emerging bulb foliage and flowers. Rake back any mulch that covers plant crowns.
- Fall clean-up (October 15 – November 15; depending upon weather conditions and condition of plant material), cut back perennials leaving 3 to 4 inches height foliage as soon as foliage has died back or at discretion of the Engineer. Do not cut into plant crowns. Do not cut back any perennial with winter interest (ornamental grasses, Echinacea/Rudbeckia seed heads).

Method of Measurement: The work will be measured for payment of surface area cared for to the satisfaction of the Engineer on the inspection date specified in the plans. The area will be computed in square yards. Measurement for payment of this work will be performed on the inspection date specified in the plans.

If the inspection discloses any work as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with such instructions and correct the unsatisfactory work on the inspection date. Work that is not acceptable on the inspection date will not be measured for payment. Individual perennial plant areas within a perennial plant bed will not be measured for payment if any portion of the perennial plant bed has not been cared for to the satisfaction of the Engineer. Each perennial plant care work cycle specified in the plans will be measure separately for payment.

Basis of Payment: This work will be paid for at the contract unit price per square yards for PERENNIAL PLANT CARE, which price shall include all materials, equipment, labor, removal, disposal and incidentals required to complete the work as specified herein and to the satisfaction of the Engineer.

FAILURE TO COMPLETE PLANT CARE AND ESTABLISHMENT WORK ON TIME

Should the Contractor fail to complete the plant care and/or supplemental watering work within the scheduled time frame as specified in the Special Provision for “Planting Perennial Plants”, “Perennial Plant Care”, and “Supplemental Watering“, or within 24 hours notification from the Engineer, or within such extended times as may have been allowed by the Department, the Contractor shall be liable to the Department in the amount of $20.00 per perennial/per day not as penalty but as liquidated damages, for each calendar day or a portion thereof of overrun in the contract time or such extended time as may have been allowed.

In fixing the damages as set out herein, the desire is to establish a mode of calculation for the work since the Department’s actual loss, in the event of delay, cannot be predetermined, would be difficult of ascertainment, and a matter of argument and unprofitable litigation. This said mode is an equitable rule for measurement of the Department’s actual loss and fairly takes into

account the loss of the tree(s) if the watering or plant care is delayed. The Department shall not be required to provide any actual loss in order to recover these liquidated damages provided herein, as said damages are very difficult to ascertain. Furthermore, no provision of this clause shall be construed as a penalty, as such is not the intention of the parties.

A calendar day is every day shown on the calendar and starts at 12:00 midnight and ends at the following 12:00 midnight, twenty-four hours later.

GENERAL REQUIREMENTS FOR WEED CONTROL SPRAYING

Experience:

The Contractor shall have previous experience with the use of weed control chemicals. He/she shall have had at least one (1) season's experience in the use of their chemicals in spraying highway right-of-way or at least three (3) season's experience in their use in farm or custom spraying. The Contractor shall observe and comply with all sections of the Illinois Custom Spray Law, including licensing.

Equipment:

The equipment used shall consist of a vehicle-mounted tank, pump, spray bar and handgun, plus any other accessories needed to complete the specified work. Spraying shall be done through multiple low-pressure flooding or broad jet nozzles mounted on spray bars operated not more than 36" above the ground. If different sizes or types of nozzles are used to make up the spray pattern, the pressure, sizes and capacities shall be adjusted to provide a uniform rate of application for each segment of the spray pattern. Hand spray guns may be used for spraying areas around traffic control devices, lighting standard and similar inaccessible areas. Maximum speed of the spray vehicle during application of chemical shall be five (5) miles per hour.

Pumps used shall have a volume and pressure capacity range sufficient to deliver the mixture at a pressure to provide the required coverage and to keep the spray pattern full and steady without pulsation or excessive pressure as to cause fogging. Maximum pressure for application shall be 15 PSI. Quick acting shut-off valves and spring-loaded ball check valves shall be provided to stop the spray pattern with a minimum of nozzle drip. In areas where the spray vehicle must traverse the right-of-way, a four-wheel drive vehicle with flotation tires will be required to minimize damage to the ground surface.

Prior to beginning work, the Contractor shall obtain approval from the Engineer of the spraying equipment proposed for completing this work. The proposed equipment shall be in an operational condition and available for inspection by the Engineer at least two (2) weeks prior to the proposed starting time. If requested by the Engineer, the Contractor shall demonstrate the calibration of the equipment.

The equipment must provide consistently uniform coverage and keep the spray mixture sufficiently agitated or the work will be suspended until the equipment is repaired or replaced.

Spraying Areas:

This work includes roadsides and other types of right-of-way of various widths and gradients. Spray areas often extend more than thirty (30) feet from the edge of the roadway, requiring both spray bar and hand gun applications.

When the description of work requires weed control of a stated species, such as teasel, the chemical shall be applied only to locations where the stated species is present. When the description of work requires general weed control within a bed or area, such as broadleaf weed control in turf, then the chemical shall be applied to the entire bed or area.

Exclusion of Spraying Areas:

Areas where weed control spraying is inappropriate or detrimental to the environment, desirable planting, or private property shall be excluded from the spray area.

Spraying will not be permitted over any drainage swales or waterways, or other areas where the chemical label prohibits application. Spraying within 150 feet of a natural area or site where endangered or threatened species occur.

Responsibility for Prevention of Damage to Private Property:

The Contractor shall, at all times, exercise extreme caution to prevent damage to residential plantings, flower or vegetable gardens, vegetable crops, farm crops, orchard or desirable plants adjacent to the roadside.

The Contractor or Department receives a complaint, the Contractor shall contact a complaint within ten (10) days after receiving a claim for damages, either in person or by letter. The Contractor, or his authorized representative, shall make a personal contact with the complainant within twenty (20) days. The Engineer shall also be notified by the Contractor of all claims for damage he received and shall keep the Engineer informed as to the progress in arriving at a settlement for such claims.

Communication with the Engineer:

The Contractor is required to communicate with the Engineer to receive all required approvals in a timely way and to assure that the Engineer can accurately document the work performed.

It shall be the Contractor's responsibility to assure that all chemical containers are opened and added to the spray mixture in the presence of the Engineer.

The Contractor shall obtain approval from the Engineer to proceed with spraying at each location 24 hours prior to the proposed spray operations.

WEED CONTROL, PRE-EMERGENT GRANULAR HERBICIDE

Description: This work shall consist of spreading a pre-emergent granular herbicide in areas as shown on the plans or as directed by the Engineer. This item will be used in mulched plant beds and mulch rings.

Materials: The pre-emergent granular herbicide shall contain the chemicals Trifluralin 2% active ingredient and Isoxaben with 0.5% active ingredient. The herbicide label shall be submitted to the Engineer for approval at least seventy-two (72) hours prior to application.

Method: The pre-emergent granular herbicide shall be used in accordance with the manufacturer's directions on the package. The granules are to be applied prior to mulching.

Apply the granular herbicide using a drop or rotary-type designed to apply granular herbicide or insecticides. Calibrate application equipment to use according to manufacturer's directions. Check frequently to be sure equipment is working properly and distributing granules uniformly. Do not use spreaders that apply material in narrow concentrated bands. Avoid skips or overlaps as poor weed control or crop injury may occur. More uniform application may be achieved by spreading half of the required amount of product over the area and then applying the remaining half in swaths at right angles to the first. Apply the granular herbicide at the rate of 100 lbs/acre (112 kg/ha) or 2.3 lbs/1000 sq. ft. (11.2 kg/1000 sq. meters).

Method of Measurement: Pre-emergent granular herbicide will be measured in place in Pounds (Kilograms) of Pre-emergent Granular Herbicide applied. Areas treated after mulch placement shall not be measured for payment.

Basis of Payment: This work will be paid for at the contract unit price per pound (kilogram) of WEED CONTROL, PRE-EMERGENT GRANULAR HERBICIDE which price shall include all materials, equipment, and labor necessary to complete the work as specified.

TRASH RECEPTACLE RELOCATION

Description: This work must consist of relocating trash receptacles at the locations specified in the Contract plans or as directed by the Engineer.

General requirements:
Contractor must remove (5) existing trash cans as noted on the demolition drawings. Trash cans shall be stored and protected during site construction. Once flatwork is complete, contractor shall install trash cans in locations noted on the drawings.

Materials: Trash Receptacle supplied by Village of Clarendon Hills:

Mounting. Surface mount. Contractor to provide all anchoring hardware.

Installation: Trash receptacles shall be surface mounted to concrete walk where indicated on the plans. Anchor bolt shall be stainless steel, ½" diameter, minimal embedment 4"

Method of Measurement: TRASH RECEPTACLE RELOCATION will be measured per each trash receptacle.

Basis of Payment: TRASH RECEPTACLE RELOCATION will be paid for at the contract unit price for each. This shall include all labor, materials, equipment and incidentals for all work involved. Cost of storage/protection and anchoring hardware shall be included in this pay item.

PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL

Description: Work shall be performed in accordance with Section 420, 421 and 424 of the Standard Specifications for Road and Bridge Construction and subsequent special provisions except as modified herein.

This work consists of furnishing all labor, materials, tools, and equipment necessary to install integral color portland cement concrete pavement and exposed aggregate portland cement on a sub-base granular material, Type B, as shown on the Contract Plans or as directed by the Engineer.

Submittals:

1. Concrete Mix Designs: Certified report identifying the design mixes, mix proportions, and additional design information meeting the requirements of Section 1020 of the Standard Specifications and this special provision.
2. Preformed Fiber Joint filler meeting the requirements of Section 1051.04 of the Standard Specifications.
3. Joint Sealant product data and color chart
4. Product Data: For each product indicated.
5. Exposed Aggregate: Submit color blend in 1-quart bag
6. Samples for Initial Selection: Manufacturer's color charts.
7. Sample Panels: 5 foot by 5 foot, sample panel to demonstrate finish, color, and texture of decorative concrete paving. Up to (5) samples shall be provided for each specialty paving.
8. Exposed aggregate portland cement concrete
9. Exposed aggregate portland cement concrete with integral color
10. Qualification Data: For Installer specified in Quality Assurance Article, including names and addresses of completed projects, Engineers, and owners.
11. Material Test Reports: From testing agency indicating compliance of concrete materials, admixtures, and similar items with requirements.

Quality Assurance:

1. Installer Qualifications. Qualified decorative concrete installer with a minimum of 5 years of experience installing decorative colored concrete and exposed aggregate concrete.

2. Source limitations. Obtain products from same source throughout project.

3. Mockups. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

    a. Northeast corner of Prospect Avenue and Burlington Avenue shall serve as mockup for basis of design quality and workmanship. Mockup shall include full-thickness sections of integral color portland cement concrete pavement and exposed aggregate concrete to demonstrate range of finishes and workmanship, typical joints, integral color; pattern and texture; and curing. Approved mockups set quality standards for comparison with remaining work. Owner and Landscape Architect to approve mockups.

b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

c. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

d. Mockups that are not approved shall be removed and a new mockup created until final mockup is approved by Engineer. Removal and reconstruction of mockups shall be included in cost of PORTLAND CEMENT SIDEWALK, 5" SPECIAL.

5. Pre-installation Conference. Conduct conference at Project Field Office. Review methods and procedures related to decorative concrete paving, including but not limited to the following:

   a. Concrete mixture design.

   b. Placement procedures. Including verification of field conditions and limits of construction. Final layout and dimensions of decorative sidewalk to be reviewed and approved by Engineer prior to placement of concrete.

   c. Quality control of concrete materials and decorative concrete paving construction practices.

   d. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:

      i. Contractor's superintendent.
      ii. Engineer
      iii. QC testing agency responsible for concrete design mixtures.
      iv. Ready-mix concrete manufacturer.
      v. Manufacturer's representative of decorative concrete paving system

Admixtures:

1. Integral Concrete Colorant: Shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194, factory pre-measured powdered mix in self dissolving packaging, consisting of non-fading finely-ground synthetic mineral-oxide coloring pigments and water reducing wetting agent.

   a. Manufacturers: Subject to compliance with requirements.

2. Color: To be a mid-gray. Refer to drawings for representative image. Final color shall be determined at based from poured samples. Color shown on contract documents is RGB 82,82,74.

3. Do not use calcium chloride or admixtures containing calcium chloride with coloring agents that are limeproof and ultra-violet resistant.

4. Raw pigments are not an equivalent and may not be substituted.

Curing Compound:

1. Integral Concrete Curing Compound: Curing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.

    a. Manufacturers: Subject to compliance with requirements.

Integral Concrete Mixes:

1. The pay item's use shall determine the class of concrete in accordance with Section 1020 of the Standard Specifications, with the exception that the minimum cement factor shall be 6.05 cwt. The coarse aggregate to be used shall contain no more than two percent by weight (mass) of deleterious materials. Deleterious materials shall include substances whose disintegration is accompanied by an increase in volume which may cause spalling of the concrete. Class SI Concrete shall conform to article 1020.04 of the Standard Specifications for Road and Bridge Construction, and as follows:

2. All admixtures proposed in the concrete mix shall be coordinated with decorative concrete manufacture's requirements.

3. Add integral concrete colorant according to manufacturer's instructions.

4. Maintain mix characteristics for all concrete required to have matching finish.

Exposed Aggregate:

1. Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
    a. Size: 1/8" to 3/4" diameter range.
    b. Shape: Rough edge
    c. Color: Shall be 40/40/20 mix of charcoal, whites, and mid grays. Refer to drawings for representative image. Final color shall be determined from the manufacturer's full range of colors and mockup installation.

Placing Of Concrete: Placing of concrete will be in accordance with Section 424.06 of the Standard Specifications for Road and Bridge Construction. Do not add water once placing has begun. Do not re-tamp concrete that has started to set. After placing and initial bull-floating, no further finishing should be performed until the bleed water has dissipated, after which final finishing can take place.

Finish: All exposed surfaces of PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL shall be a sand blast. Finishing techniques must be consistent. Differing finishing techniques will change the appearance of the color.

Allow concrete to cure to sufficient strength so that it will not be damaged by blasting but not less than seven days. Use light or medium sandblasting to surfaces as indicated on the plans

to remove cement mortar from surface and expose aggregate to match originally approved mockup and example in contract documents.

1. Blasting Operations and Requirements:
   a. Repair and patch tie holes and defective areas. Remove fins and other projections.
   b. Apply sandblasted finish to all surfaces of concrete to view in finished project.
   c. Perform sandblasting at least 72 hours after placement of concrete and compressive strength of concrete exceeds 2000 psi. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be blast finished are blasted at the same age for uniform results.
   d. Determine type of nozzle, nozzle pressure, and blasting techniques required to achieve specified finish.
   e. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line.

2. Depth of Cut: use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surface to achieve specified finish as follows:
   a. Medium Sand Blast Finish: Expose coarse aggregate with a minimum 3/16" and maximum 1/4" reveal

3. Treating Surface Imperfections:
   a. Mix patching compound or grout material with dust created by grinding operations, manufacturer's tint, or sand to match color of adjacent concrete surfaces.
   b. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids with grout to eliminate micro pitting in finished work.
   c. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.

Joints: The pavement joints shall be tooled with edger no less than ¼" deep and have ¼" radius. The Contractor shall provide a working field drawing depicting the locations of all staging and construction joints to the Engineer for review and approval prior to placement of concrete. Both the staging and construction joints shall conform to the scoring pattern as shown on the drawings and/or in accordance with the standard specifications. The joint pattern shall be established and approved by the Engineer prior to pouring of the concrete. ¾ in (20 mm) thick expansion joints shall also occur between pavement and curbs, walls, structures, integral color concrete and footings.

Expansion Joints: Expansion joints shall be in accordance with Section 424.07 of the Standard Specifications for Road and Bridge Construction and as shown on the plans. Joint sealer shall be self-leveling cold-poured joint sealer with performance complying with the following products: Sealant color shall match the color of PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL. Sealant color shall be selected by the Engineer from the manufacturer's available colors.

Field Quality Control: Remove and replace concrete which does not satisfy the performance requirements of specification included in contract, which does not conform to grades and profiles shown on the Drawings, contains cracks, spalling or other defects which impairs the

strength, safety or appearance of the work, or has been damaged or discolored during construction. Protect the Work from damage until accepted.

The contractor is responsible for protecting fresh concrete. Any damage to the new sidewalk from graffiti, footsteps, rain, etc. should be corrected immediately. No payment for the sidewalk will be made until the corrections are made. All corrections including removal and replacement will be at the contractor's expense. Skim patches, grinding, and cover coats will not be permitted as an acceptable means for repairing defects in concrete finish.

Method of Measurement: PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL shall be measured in place in square feet of paving. SUB-BASE GRANULAR MATERIAL, TYPE B 6" shall be measured installed per square yard.

Basis of Payment: PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL shall be paid for at the contract unit price, which price shall include payment for mock ups, joints including bituminous preformed joint filler with joint sealant, furnishing and installing all required concrete including integral color, aggregate, earth excavation, and backfill as required to perform the work as specified herein. SUB-BASE GRANULAR MATERIAL, TYPE B shall be paid for separately.

BENCHES

Description: Provide materials and labor for the installation of cast stone benches supplied by the Engineer at locations indicated on the drawings and specified herein.

Setting Bed
Thickened Portland cement concrete slab underlay cast masonry units, refer to drawings for thickness. This shall be included in the cost of the bench.

Portland cement concrete to match standard requirements.

Examination
Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

Proceed with installation only after unsatisfactory conditions have been corrected.

Setting Anchored Cast Stone
Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.

Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform spacing.

Benches shall be set on thickened concrete edge with ½" threaded stainless steel dowel set in epoxy. Cost of thickened concrete walk edge shall be included in the cost of the bench.

Installation Tolerances
Variation from Plumb: Do not exceed 1/8 inch in 10 feet maximum.

Variation from Level: Do not exceed 1/8 inch in 10 feet maximum.

Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

Adjusting and Cleaning
In-Progress Cleaning: Clean cast stone as work progresses.

Remove mortar fins and smears before tooling joints.
Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.

Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

Method of Measurement: BENCHES shall be measured installed per each.

Basis of Payment: BENCHES shall be paid for at the contract unit price, which price shall include retrieving from their stored location at the Village, preparation of base, and installation for all work involved. Thickened edge of concrete shall be included in the cost of this pay item.

BUILDING CONCRETE

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 030516
UNDERSLAB VAPOR BARRIER

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS
A. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.
B. Section 032000 - Concrete Reinforcing.
C. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS
A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011 (Reapproved 2017).
B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.04 SUBMITTALS
A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products.
C. Samples: Submit samples of underslab vapor barrier to be used.
D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS
2.01 MATERIALS
A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m2 Pa)), maximum.
   2. Complying with ASTM E1745 Class A.
   3. Thickness: 15 mils (0.4 mm).
   4. Acceptable Manufacturers:
      a. Stego Industries, LLC; Stego Wrap 15-MIL Vapor Barrier - Class A: www.stegoindustries.com.
      b. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com.
      c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION
A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

C. Lap joints minimum 6 inches (150 mm).
D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 031000
CONCRETE FORMWORK

PART 1 - GENERAL
1.01 SUMMARY:

A. Section Includes:
1. Temporary formwork, shoring for site work, foundations, foundation walls, piers, and walls.
2. Integrally insulated cast-in-place concrete wall system (R20) with board-formed finish and smooth finish as indicated on the Drawings.
3. Smooth finished concrete at cast-in-place benches.
4. Mock-ups as indicated on the Drawings.

B. Related Sections:
1. Specifications sections 032000 Concrete Reinforcing Bars and 033000 Concrete.
2. Refer to Project Manual Appendix for additional information regarding the Integrally Insulated Cast-in-Place Concrete Wall System.

1.02 STANDARDS:

A. Codes and Standards: Provide work performed in accordance with municipal Building Code and pertinent provisions of the following codes and standards:

1.	ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
2.	ACI 301	Standard Specifications for Structural Concrete
3.	ACI 302.1R	Guide for Concrete Floor and Slab Construction
4.	ACI 303.1	Specification for Cast-in-Place Architectural Concrete, for formed surfaces exposed to view
5.	ACI 318	Building Code Requirements for Structural Concrete
6.	ACI 347.2R	Guide for Shoring/Reshoring of Concrete Multistory Buildings.
7.	ASCC	American Society of Concrete Contractors, “As Cast Concrete Guide for Surface Finish of Formed Concrete,” Classifications P2 and P3.

B. In case of conflict among the listed documents, the most restrictive provisions govern.

1.03 FORMWORK DESIGN AND ENGINEERING

A. The formwork Subcontractor shall retain or employee a licensed Professional Engineer, registered in the State of Illinois, to design and engineer formwork, including shoring and re shoring calculations, using the listed standards, including ACI-347R.
B. Provide formwork design and engineering as necessary to carry sustained and temporary loads applied during construction.
C. Design and provide formwork, including shoring and re-shoring procedures, in a manner such that the total construction load does not, at any time, exceed the total design load,

as determined from the Drawings. The total design load consists of self-weight of the structure, design superimposed dead loads, and design live loads.

D. Detail formwork to be readily removable without impact, shock, or damage to cast in place concrete surfaces and adjacent materials.

1.04 SHORING AND RE-SHORING

A. Provide one level of shoring and three levels of re-shoring, at minimum.

B. Shores must be removed and re-shores installed in a sequence such that each floor is allowed to deflect and carry its own weight prior to the installation of re-shores.

C. For flat plate or flat slab construction, backshores and preshores, as described by ACI 347, are prohibited.

1.05 QUALITY ASSURANCE

A. Qualifications: The work of this section shall be performed by a company with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts. Provide at least one responsible site superintendent who shall be present and shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all work performed under this Section.

B. Codes and Standards: Design, construct, install, maintain, and remove forms and related structures in compliance with American Concrete Institute Standards, ACI 347R, "Guide to Formwork for Concrete", and ACI 318/318R, "Building Code Requirements for Reinforced Concrete with Commentary."

C. Engineering: Provide forms engineering, under the direct supervision of a licensed Professional Engineer registered in the State of Michigan. Submit for information, signed and sealed calculations and formwork design drawings.

D. Allowable Tolerances: Construct formwork to provide completed cast in place concrete surfaces complying with the tolerances specified in article, "Tolerances", in Section 03 30 00. Before concrete placement, check the lines and levels of installed formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed work will be within the specified tolerances.

1.06 SUBMITTALS

A. Shop Drawings: Submit for review and approval, shop drawings indicating dimensioned forms layout, form tie layout, form-liner layout, transition / edge & corner details, reveals, and construction joints. Indicate dimensioned, plan and elevation locations and dimensions of completed concrete members.

1. Surfaces exposed to view:
    a. Minimize joints. Submit joint layout for review.
    b. Arrange panels neatly along a regular, symmetrical grid.

B. Shoring / Re-shoring Drawings: Submit stamped drawings, for information, indicating layout, procedures, and sequencing of shoring / re-shoring.

C. Shoring / Re-shoring Calculations: Retain a registered structural engineer, licensed in the State of Michigan, to provide shoring / re-shoring calculations based on ACI 347 procedures. Submit for information, stamped calculations, limiting total load imposed on any level, to floor slab total service design load, as determined from the structural Drawings. Floor slab total service design load, consists of self-weight, listed superimposed dead load, and listed live load.

D. Samples: Submit for information, samples of form ties, anchor inserts and 12" long sections of dovetail slots and waterstops. For concrete exposed to view, provide three 2-ft by 2-ft samples of form-facing panel.

E. Mock-up sample installations of board-formed formwork and finishes; and smooth formwork and finishes for review and approval by Owner and Architect.

a. Review and approval of formwork and form liners by Owner and Architect prior to pouring concrete mock-ups.

F. Weekly Progress Diagrams: Submit for information, weekly progress diagrams.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. On delivery to job site, place materials in area protected from weather.

B. Store materials above ground, on framework or blocking, cover with protective waterproof covering, provide for adequate air circulation and ventilation.

C. Handle materials to prevent damage.

PART 2 - PRODUCTS

2.01 APPEARANCES OF FORMED SURFACES:

A. Surfaces exposed to view:

1. Minimize joints. Submit joint layout for review.
2. Arrange panels neatly along a regular, symmetrical grid.
3. Secure panels tightly to prevent leakage.
4. Provide form design, clean-up, and coating to promote a smooth-form finish, with well dispersed bug holes (surface voids) and only a few reaching as large as ¼-in. across (ASCC Classification P2.)
5. Provide form design and construction to limit combined abrupt and gradual change over any 5 ft of formed surface, limited 1/8 in. (ACI 347, Table 3.1, Surface Class A.)
6. Provide form joint tape and joint sealant to maintain a watertight corner.
7. Submit tie-hole layout for review.
8. Use of patched form surface is prohibited.

B. Surfaces not-exposed to view or in back-of house:

1. Submit joint layout for review.
2. Arrange panels neatly along a regular, symmetrical grid.
3. Secure panels tightly to prevent leakage.
4. Provide form design, clean-up, and coating to promote an ordinary smooth-form finish, with numerous evenly scattered bugholes (surface voids) and most of them in the 1/8-in. to ¼-in. range (ASCC Classification P3.)
5. Provide form design and construction to limit combined abrupt and gradual change over any 5 ft of formed surface, limited 1/4 in. (ACI 347, Table 3.1, Surface Class B.)
6. Use of patched form surface is prohibited.

2.02 FORM FACING MATERIALS

A. Surfaces exposed to view:

1. Forms: Overlaid plywood or steel plate, providing continuous, straight and smooth surfaces. Overlaid plywood shall have a laminate, high density face applied to Douglas fir plywood complying with U.S. Product Standard PS 1 with each piece edge sealed and bearing the APA grade trademark.
2. At interior side of integrally insulated cast-in-place wall system (R20) and cast-in-place bench.
   a. Smooth-Formed Finish Concrete: Smooth plexi-glass or fiberglass.
3. At the exterior side of integrally insulated cast-in-place wall system (R20).
   a. Board-formed concrete using natural wood boards for the form liner as indicated on the Drawings.

B. Use only new or un-damaged form material.

2.03 INTEGRALLY INSULATED CAST-IN-PLACE CONCRETE WALL SYSTEM

A. Product: Thermomass

B. Fiber-composite connectors and pre-cut rigid insulation with pre-installed twist-lock retainers.
   1. ASTM C581
   2. ASTM D790
   3. ASTM D3039/D3039M
   4. ASTM E488

C. Insulation: 4” extruded polystyrene (XPS) R20

D. Material & Physical Properties

1.	Tensile Strength	869 N/mm2 (120 ksi)
2.	Elongation at Fracture	2.1%
3.	Flexural Strength (Strong Axis)	827 N/mm2 (120 ksi)
4.	Compressive Strength	465 N/mm2 (67.4 ksi)
5.	Shear Strength	400 N/mm2 (58 ksi)
6.	Flexural Elasticity Modulus	32,800 N/mm2 (4,764 ksi)
7.	Tensile Elasticity Modulus	40,000 N/mm2 (5,800 ksi)
8.	Rockwell Hardness E, minimum	70
9.	Cross Section	5.7x10mm (0.22x0.39 in)
10.	Cross Sectional Area at Least Section	50.5 mm2 (0.078 in2)
11.	Moment of Inertia at Least Section	243 mm4 (0.0005858 in4)

2.04 FORM TIES

A. Provide factory fabricated, snap off "washer type" metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Provide ties with integral hot forged heads so that portion remaining within concrete after removal of exterior parts is at least 1-1/2" from the outer concrete surface. Form ties fabricated on the site and wire ties are not acceptable.

B. Must be compatible with integrally insulated cast-in-place concrete wall system.

2.05 DOVETAIL SLOTS

A. Dovetail slots shall be 24 gauge, galvanized, filled or taped, as manufactured by Dayton Superior Corp, Vulcan Metal Products, Heckmann Building Products or Gateway Building Products.

2.06 WATERSTOPS

A. Waterstops shall be strip bentonite, 1" x .75" x 16.66' rolls; "Waterstop RX" (American Colloid Co.) "101" or "102" size as determined by thickness of concrete and number of rows of reinforcing steel. Provide manufacturers recommended adhesive primer or concrete cut nails for temporarily securing strip in place.

2.07 FORM COATINGS

A. Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of those surfaces. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.08 FORM JOINT TAPE

A. Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.

2.09 FORM JOINT SEALANT

A. Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.

2.10 FORM LINERS

A. Form liners shall be located as indicated on the Drawings.
   1. Supply manufacturers recommended fasteners, spaced as required.

2. At interior side of integrally insulated cast-in-place wall system (R20), cast-in-place concrete bench, and exposed portions of column bases located in landscape areas.
   a. Smooth-Formed Finish Concrete: Smooth plexi-glass or fiberglass.
3. At the exterior side of integrally insulated cast-in-place wall system (R20).
   a. Board-Formed Concrete using natural wood boards for the form liner as indicated on the Drawings.

PART 3 - EXECUTION

3.01 FORMWORK

A. General: Construct forms to the sizes, line and dimensions shown, and as required to obtain accurate alignment, location, grades. Level and plumb work in finished structures. Formwork shall be sufficiently tight to minimize leakage of cement paste during concrete placement. Solidly butt joints and provide back up material at joints, as required, to minimize leakage and fins.

B. Formwork for Grade Beams: Side forms are required for grade beams unless shown otherwise on Drawings.

C. Location of construction joints shall only be installed at locations shown on the final shop drawings.

D. Erect and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

F. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures as specified in article "Tolerances," in Section 03300.

G. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

H. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of cement paste. Locate temporary openings in forms at inconspicuous locations consistent with project requirements.

I. Forms for Exposed Concrete:
   1. Drill forms to suit ties used, and to prevent leakage of concrete material around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
   2. Where reveals are indicated on Drawings, ties shall be located in reveals. Ties between reveals at exterior exposed surfaces shall be located in regular rectangular patterns.
   3. Do not use metal cover plates for patching holes or defects in forms.
   4. Provide sharp, clean corners, without visible edges of offsets, at intersecting planes. Back joints with extra studs or girts to maintain true, square intersections.
   5. Use extra studs, walers and bracing, to prevent bowing of forms between studs, and to avoid bowed appearance in concrete. Do not use narrow strips to form material which will produce bow.
   6. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
   7. Form molding shapes, recesses, and projections, with smooth finish materials, and install them with sealed joints to prevent displacement.

8. Form intersecting planes to provide true, clean cut corners, with edge grain of plywood not exposed to concrete.

J. Form Liners: Provide as indicated on the Drawings.
1. Assemble and brace the architectural side of the formwork.
2. Apply foam tape to back side of liner along edges to seal liner to formwork.
3. Position form liners on the form so that the grooves and joints are aligned with form ties.
4. Execute any over-lap of liners to provide a smooth, continuous surface.
5. Cut openings and trim liner edges with tools recommended by manufacturer.

K. Corner Treatment
1. Chamfer locations and profiles as indicated on the drawings.
2. Form chamfers with strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
3. Form corners square as indicated on the drawings.

L. Edge Sealing:
1. Plywood forming materials shall be edge sealed with an effective water excluding coating. Any cutouts, holes or field cuts shall also be sealed.

M. Support form facing materials, by structural members spaced sufficiently close, and of sufficient stiffness so as to produce finished concrete surfaces within the tolerances specified in Section 033000 and as indicated on the Drawings. To avoid variations between panels, support panel edges. Fit forms placed in successive units, for continuous surfaces, to accurate alignment, free from irregularities, and within allowable tolerances.

N. Provide shores and struts, with positive means of adjustment.

O. Camber formwork equal to slab camber indicated on Drawings.

P. Bracing:
1. Construct all bracing, supporting members, and centering of ample size and strength to carry all dead and live loads to which they may be subjected.
2. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.

3.02 INSTALLATION OF EMBEDDED ITEMS

A. Provide formed openings, where required, for pipes, conduits, sleeves, and other work embedded in, and passing through, concrete members.

B. Build into construction all wall ties, anchors, dowels, inserts, wood blocks, nailing strips, grounds, anchor slots, reglets, etc., as required. Set all anchors, etc., in forms as furnished and located by other trades for support of various items of work (including curtain wall, storefront, and elevator divider beam anchorages). "Box outs" shall be provided by this Subcontractor. Have all locations approved and verified after placement by each respective Subcontractor.

C. Coordinate work of other sections and cooperate with trades involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts. Do not perform work unless it has been specifically indicated on the Drawings, or has been reviewed for compliance prior to installation.

D. Accessories: Install concrete accessories in accordance with manufacturer's recommendations, straight, level, and plumb. Ensure that the items are not disturbed during concrete placement. Install dovetail anchor slots for securing of masonry walls and facing. Slots shall be full height of wall or column.

E. Control Joints: Provide control and construction joints, including wood screeds, metal keyways and sawcuts. Place formed construction joints in floor slab pattern pouring sequence. Set top screed to required elevations. Secure to resist movement of wet concrete.

F. Keyways: Provide keyways at least 1 1/2" deep in construction joints in walls, slabs and between walls and footings.

G. Edge Forms and Screed Strips: Set edge forms, bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

H. Waterstops: Install waterstops continuous against clean and dry concrete surfaces. They shall not be applied in standing water or on honeycombed, spalled, or other irregular surfaces. Irregular surfaces shall be grouted and made reasonably smooth.
   1. Apply a strip of waterstop directly to the joint in a location which will result in its being contained within the joint after the next concrete pour. Butt the two ends together for splicing.
   2. At wall footing joints, place the waterstop outside of the exterior row of reinforcing steel, if a minimum of 2" of concrete cover can be attained. In the case where a minimum of 2" of concrete cover can not be attained by placing the waterstop on the exterior side of the steel, the waterstop shall be placed along the interior side of the outermost row of reinforcing steel to insure that adequate concrete coverage is attained. Placement of the waterstop in the keyway shall be avoided since this area is most likely to be subjected to ponding water prior to placement of the wall above.
   3. Prior to confinement within a concrete joint, the bentonite material shall not be submerged in standing water so that it exhibits swelling. In the event that the material does exhibit swelling, it shall be replaced with new material.

I. Temporary Openings: Provide temporary ports or openings in formwork, where required, to facilitate cleaning and inspection. Locate temporary openings at bottom of forms to allow flushing water to drain. Close temporary ports of openings with tight fitting panels, flush with inside face of forms, and neatly fitted so that joints will not be apparent in exposed concrete surfaces.

3.03 PLACEMENT OF CONDUITS, PIPES AND SLEEVES

A. All conduit, pipes, sleeves for pipe lines and inserts for support of pipe hangers required for plumbing, heating, ventilating and electrical work, will be furnished and installed by the respective trades involved. This Subcontractor shall be responsible for coordinating the location and maintaining these items plumb, in alignment and in place.

B. Conduits, pipes and sleeves of any material not harmful to concrete and within limitations of this Paragraph may be embedded in concrete subject to the review of the Structural Engineer. Location of the reinforcing steel shall have priority over the location of all conduit, pipes or sleeves. In case of conflicts between the reinforcing and conduit, pipes or sleeves this Subcontractor shall notify the Structural Engineer immediately. If Subcontractor fails to request interpre¬tation, all required changes shall be made without additional cost to the Design/Builder.
   1. Conduits and pipes, with fittings embedded within a column shall not displace more than 2 percent of the area of cross section.
   2. Except when Shop Drawings for conduits and pipes are otherwise reviewed by the Structural Engineer, conduits, pipes and sleeves embedded within a slab (other than those passing through) shall satisfy the following:
      a. Conduits and pipes shall not be larger in outside dimension than 1/3 the overall thickness of the slab in which they are embedded.
      b. Conduits and pipes shall not be spaced closer than 3 diameters or widths on center of the largest conduit or pipe.
      c. They shall have 1" or more of concrete cover and be placed above bottom reinforcing.
      d. They shall not be tied to parallel reinforcing steel.
      e. They shall not be placed parallel to the longitudinal axis of beams, columns or shear walls.
      f. Necessary accessories and supports for conduits and pipes shall be provided to insure concrete cover over reinforcing steel.

g. If the placement of conduit, pipes and sleeves cannot satisfy the above requirements, this Subcontractor shall submit Shop Drawings to the Structural Engineer for review.

3.04 REVIEW OF FORM LINERS

A. Review and approval of formwork form liners by Owner and Architect is required prior to pouring concrete mock-ups.

3.05 FORM COATINGS

A. Coat form contact surfaces with form coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust preventative form oil or otherwise protect against rusting. Rust stained steel formwork is not acceptable.

3.05 CLEANING AND TIGHTENING

A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement, as required, to eliminate mortar leaks.

B. Carefully inspect falsework and formwork, during and after concrete placement operations, to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.

3.06 REMOVAL OF FORMS

A. Slab forms shall not be removed until the slab concrete test results indicate that concrete has reached at least 75% of the specified strength.

B. Re-shores shall be left in place until the total strength of the re shored slabs have reached sufficient capacity to carry the dead and impact loads of the floors being placed overhead. Re-shoring shall not be spaced more than 9 ft apart; and a pattern shall be established so re-shores always occur above re-shores.

C. Strength of concrete shall be established by laboratory cured test cylinders. If stripping is to occur before standard cylinder test reports specified in Section 03300 are available, additional cylinders shall be taken for this purpose at the expense of the Contractor.

D. Remove formwork progressively, so that no shock loads or unbalanced loads are imposed on the structure. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

E. Construction materials are not to be stored on the slabs during the period between the stripping of bottom forms and the re shoring.

3.07 FORM RE-USE

A. Clean, remove laitance and repair surfaces of forms to be re used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Align and secure joints to avoid offsets and tighten to close all joints.

1. Limit re-use of actual wood form liner material for areas of architectural board-formed concrete.

B. Apply new form coating compound material to concrete contact surfaces as specified for successive concrete placement.

3.08 SLAB UNDERSIDE REPAIR

A. After stripping forms for all ceiling, slab edge, wall and column surfaces, remove nails, fins, protrusions and form materials and particles.

END OF SECTION

SECTION 032000

CONCRETE REINFORCING BARS

PART 1 - GENERAL

a. SUMMARY:

A. Section Includes:
   1. Reinforcing bars and associated items.

B. Related Sections:
   1. Division 1 Sections.
   2. Section 03 10 00, "Concrete Formwork"
   3. Section 03 30 00, "Concrete"

1.02 STANDARDS:

A. Codes and Standards: Provide work performed in accordance with the City of Chicago Building Code and pertinent provisions of the following codes and standards:

1.	ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials.
2.	ACI 301	Standard Specification for Structural Concrete.
3.	ACI 315	Details and Detailing of Concrete Reinforcement.
4.	ACI 318	Building Code Requirements for Reinforced Concrete.
5.	ASTM A 82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
6.	ASTM A 108	Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
7.	ASTM A 123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
8.	ASTM A 143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
9.	ASTM A 185	Standard Specification for Steel Welded Wire Fabric, Plain, For concrete Reinforcement.
10.	ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
11.	ASTM A 496	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
12.	ASTM A 497	Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
13.	ASTM A 615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
14.	ASTM A 706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
15.	ASTM A 767	Standard Specification for Zinc-Coated (Galvanized) Bars for Concrete Reinforcement.
16.	ASTM A 775	Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
17.	ASTM A 884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
18.	ASTM B 633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
19.	ASTM C 578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
20.	ASTM D 994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
21.	ASTM D 1751	Standard Specification for Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type).

22. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
23. AWS D1.1 Structural Welding Code-Steel.
24. AWS D1.4 Structural Welding Code-Reinforcing Steel.
25. AWS D12.1 Recommended Practices for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction.
26. CRSI Manual of Standard Practice.

B. In case of conflict between the listed documents, the most restrictive provisions govern.

1.03 QUALITY ASSURANCE

A. Qualifications: The work of this section shall be performed by a company with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
B. Reinforcing steel supplier and reinforcing steel Subcontractor proposed by the Contractor must be identified in the Bid Submission.
C. Owner's testing agency shall inspect installed reinforcing bars:
   1. Verify reinforcing bar quantity, size, location, and support.
   2. Verify concrete cover.
D. Reinforcing steel subcontractor shall coordinate and schedule access for the Owner's testing agency to inspect installed reinforcing bars.

1.04 SUBMITTALS

A. Shop Drawings: Submit for action, shop drawings for fabrication, bending, and placement of reinforcing bars. Shop Drawings shall include, but not be limited to:
   1. All details, dimensions and information required for fabrication and placement to reinforcing bars and embedded assemblies, prepared in accordance with ACI 315, "ACI Detailing Manual."
   2. Diagrams of bent bars, grade designations, bar schedules, bar sizes, stirrup spacing, and arrangements of embedded assemblies.
   3. Hooks, detailed per ACI 318, indicating dimensions of hooks. Splices, detailed per ACI 318, indicating lengths of splices. Sections, with dimensions of reinforcement clearances and concrete cover.
   4. Openings, sleeves, and items of other trades, including any interferences.
   5. Support bars and spacing devices, including miscellaneous accessories.
   6. Construction joint type, details and locations.
   7. Provide a table of quantities on each shop drawing, listing weights of bars detailed on that shop drawing. Table of quantities on each shop drawing will be used as basis for determining reinforcement quantities.
   8. Provide shop drawings without re-producing structural Drawings. Do not use scaled dimensions to determine bar lengths.
B. Schedule of shop drawing submittals: Submit for information, a submittals schedule, a minimum of 30 days in advance of the first submittal. Submit shop drawings only in conformance with an agreed schedule.
C. Product Data: Submit for information, installation instructions and reports.
D. Epoxy System: Submit for information, epoxy coating manufacturer's product data or letter of certification that epoxied product has been tested and approved for use by the Federal Highway Administration and the National Bureau of Standards.
F. Mill Reports: Submit for information, certified reports of mill tests. Tests to include chemical analysis, tensile and bend test for reinforcing bars and welded wire fabric.
G. Samples: Submit for information, two samples of each type of bar supports and mechanical bar splices.
H. Steel Delivery Tickets: Maintain a record at the site, showing date and time of delivery.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver reinforcement to the Project Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Protection: Protect concrete reinforcement before, during, and after installation. Protect the materials and installed work of all other trades. Maintain identification of fabricated bars after bundles are broken.

C. Storage: Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

D. Epoxy Coated Reinforcement:

1. Contact areas of handling and hoisting systems shall be padded or be made of nylon or other acceptable material.
2. Use spreader bars to lift bundles of coated steel to prevent bar to bar abrasion.
3. Pad bundling bands or fabricate of nylon or other acceptable material.
4. Store coated steel on padded or wooden cribbing.
5. Do not drag coated steel members.
6. After placement, restrict traffic on coated steel to prevent damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: Deformed Steel Bars, ASTM A615, Grade 60, except where noted as Grade 75.

1. Where indicate on drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
2. Epoxy-Coated: ASTM A 775. Damaged epoxy-coating shall be repaired with patching material conforming to ASTM A775. Repair shall be done in accordance with the patching material manufacturer's recommendations.
3. Weldable reinforcement: ASTM A 706.

B. Welded Wire Fabric: Plain finish, ASTM A 82/ASTM A 185, and deformed, ASTM A 496/ASTM A 497.

1. Epoxy-Coated Welded Wire Fabric: ASTM A 884, Class A.

C. Accessories and Supports for Reinforcement: Provide bar supports and other accessories in accordance with CRSI "Recommended Practice for Placing Reinforcing Bars" and, if necessary, additional support to hold bars in proper position while concrete is being placed. Supports shall be of metal, concrete, fiber-reinforced cement, plastic, or other material.

1. Supports for Reinforcement shall comply with the following:
   a. Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, hot-dip galvanized after fabrication in accordance with ASTM A 123.
   b. For contact with forms use types with not less than 3/32” of plastic between metal and concrete surface. Plastic tips shall extend not less than ½” on metal legs.
   c. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound load without damage or permanent distortion.
   d. Unless otherwise indicated on drawings, bottom reinforcing bars in footings shall be supported by precast concrete blocks or individual high chairs with welded sand plates.
   e. For slabs on grade use supports with sand plates or horizontal

runners where base material will not support chair legs.

2. Metal Supports: Shall be one of the following type(s):
   a. Plastic -coated wire (Class 1 - maximum protection). Legs shall be plastic coated or have pre-molded slip-on plastic tips.
   b. Stainless steel protected wire (Class 2 - moderate protection). Legs shall be of stainless steel or of carbon steel with stainless steel leg extensions.
3. Precast Concrete Supports: Shall be of the following type(s):
   a. Plain.
   b. With wires. For use with epoxy-coated bars, wires shall be epoxy-coated.
   c. Doweled. For use with epoxy-coated bars, dowels shall be epoxy-coated.
4. Cementitious Fiber-Reinforced Supports: Shall be of the following type(s):
   a. Plain.
   b. For use with epoxy-coated bars, wires shall be epoxy-coated.
5. Plastic Supports: Shall have at least 25% of their gross plane area perforated to compensate for the difference in the coefficient of thermal expansion between the plastic and concrete. All-plastic supports may be used to support epoxy-coated bars.
6. Epoxy-Coated Supports: When using epoxy-coated reinforcing bars, provide the following:
   a. Wire bar supports shall be coated with dielectric (non-conducting) material compatible with concrete, such as epoxy or plastic, for a distance of at least 2 inches from the point of contact with the epoxy-coated reinforcing bars, or
   b. Bar supports shall be made of dielectric material. In addition, if precast concrete blocks with embedded wire ties or precast concrete doweled blocks are used, the wires or dowels shall be epoxy-coated or plastic-coated, or
   c. Reinforcing bars that are used as support bars shall be epoxy-coated. In walls reinforced with epoxy-coated bars, spreader bars (where specified) shall also be epoxy-coated.

D. Splicing System: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318.
1. For mechanical tension and compression splices of reinforcing steel where specifically detailed on drawings, use Cadweld (C-series) splice, Dayton BARGRIP, NMB splice sleeve or Erico Lenton splices installed in strict compliance with manufacturer's requirements.
2. For welded splices, comply with ACI 318.
3. Tensile splicers shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.
4. Compression splicers shall be the mechanical type such that the compression stress is transmitted by end bearing held in concentric contact.

2.02 FABRICATION

A. General Requirements: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication to tolerances complying with CRSI "Detailing Manual". In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material. Fabrication tolerances shall comply with ACI 117.

B. All reinforcement shall be bent cold unless otherwise permitted by the Structural Engineer.

C. Unacceptable Workmanship: Reinforcement with any of the following defects will not be permitted in the work:
1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.

2. Bends or kinks not indicated on Drawings or final shop drawings.
3. Bars with reduced cross-section due to excessive rusting or other cause.

D. Sheared ends of epoxy-coated reinforcement shall be touched-up with an epoxy coating.

PART 3 - EXECUTION

3.01 PLACING REINFORCEMENT

A. General Requirements; See Paragraph 3.01,F., below for epoxy coated reinforcement:
1. All reinforcing bars shall be placed in accordance with CRSI "Recommended Practice for Placing Reinforcing Bars".
2. Bars shall be placed to the tolerance specified in ACI 117.
3. Place all reinforcement according to the Construction Documents and the reviewed Shop Drawings. Use sufficient bar supports, tie, anchors, additional reinforcing bars if required, and other accessories to hold all bars securely in place.

B. Concrete Cover: Place reinforcement to obtain concrete indicated by Drawings.

C. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operation. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

D. Bar Supports: Provide sufficient number of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways or conveying equipment and similar construction loads. Do not "tack" weld bars for support. All-plastic supports shall be spaced not more than 12 inches apart along bars.

E. Dowel Positioning: Dowels from footings to walls and piers shall be same spacing as wall or pier reinforcement as shown on the Drawings, and shall project into the wall or pier a distance equivalent to 30 bar diameters, except as otherwise indicated.

F. Installation Requirements; Epoxy Coated Reinforcement:
1. Rest epoxy coated steel reinforcement supported from formwork on coated wire bar supports.
2. Bar supports shall be coated with dielectric material for a minimum distance of 2 inches from the point of contact with the coated steel reinforcement.
3. Fasten epoxy coated steel reinforcement members with nylon , epoxy , or plastic coated tie wire.
4. Mechanical connections, when required, shall be installed in accordance with the splice device manufacturer's recommendations. Repair any damage to coating.
5. All parts of mechanical connections on epoxy coated steel reinforcement, including steel splice sleeves, bolts, and nuts shall be coated with the same material used for repair of coating damage.
6. Do not cut epoxy coated steel reinforcement unless permitted by the Structural Engineer. When cut, coat ends with material used for repair of coating damage.
7. Field inspection of installed coated material will be performed under provisions of Section 01410, "Testing Laboratory Services".
8. Coating damage due to fabrication and handling need not be repaired where the damaged area is 0.1 square inch or smaller.
9. Repair damaged areas larger than 0.1 square inch using manufacturer's recommended patching material and method.
10. The maximum amount of total damage (total of Subparagraphs "F.8." and "9.") shall not exceed 2% of the surface area of each reinforcing bar; if in excess, repair as specified.
11. Fading of the color of the coating shall not be cause for rejection of epoxy coated reinforcing bars.

3.02 REINFORCING BAR SPLICES

A. Except as provided in Paragraph 2.01, D., herein, for welded splices, provide standard reinforcement splices by lapping ends, placing bars in contact, and tying wire tightly. Comply with requirements in ACI 318 for minimum lap of spliced bars and as indicated on Drawings.

3.03 CLEANING REINFORCEMENT

A. Steel reinforcement, at the time concrete is placed around it, shall be free from loose rust and mill scale, oil, grease, paint, earth, ice, concrete mortar and all other coatings, which would reduce bond between steel and concrete. Clean reinforcement with hand tools, as needed.

3.04 PLACEMENT OF WELDED WIRE FABRIC

A. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction. Place welded wire fabric on top of reinforcement or on chairs or spacers as indicated.

3.05 BID FORM

A. Provide a tonnage allowance for the entire project.
B. Provide a unit price, per ton of in-place reinforcing bars, for use in determining adjustments.

END OF SECTION

SECTION 033000
CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Specifications sections 031000 Concrete Formwork and 032000 Concrete Reinforcing Bars.
B. Refer to Project Manual Appendix for additional information regarding the Integrally Insulated Cast-in-Place Concrete Wall System.
C. Refer to Drawings for additional information regarding the Architectural Board Formed Concrete Finish.

1.02 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes for the following:
   1. Footings
   2. Foundation Walls
   3. Integrally Insulated Cast-in-Place Concrete Wall System R20 (Thermomass)
   4. Slabs-on-grade
   5. Concrete toppings
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
C. Related Work
   1. Section 033511 Concrete Polishing
D. Definitions
   1. Structurally Composite Wythe Connectors: Structurally composite wythe connectors designed to transfer high shear forces that are generated due to longitudinal bending from one concrete wythe to the other, thus providing composite action. Composite action is achieved by transferring forces from one wythe to the other by using wythe tie connectors. The wythe tie should be solely responsible for transferring forces.

2. Structurally Non-Composite Wythe Connectors: Structurally non-composite wythe connectors have sufficient shear capacity to transfer the dead load of a typical fascia wythe. They are not capable of transferring shear forces due to the longitudinal bending of the panel. Typically, a non-composite wythe connector is flexible and will bend due to temperature induced forces.

E. References
1. BSR/ASHRAE/IESNA 90.1
2. ASHRAE Handbook of Fundamentals
3. Energy Policy Act of 2005
4. ACI 318 Building Code Requirements for Structural Concrete
5. ICC-ES Acceptance Criteria 320
6. ASTM C 581
7. ASTM D 3039

1.03 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix.
1. Include field test data used to establish the required average strength in accordance with ACI 301.
2. Review of design mix and field test data will be for general information only. Production of concrete to comply with specified requirements is the responsibility of the contractor.
3. Submit written reports to Architect of proposed mix at least 15 days prior to start of work. Do not begin concrete production until each mix has been reviewed by the Architect.
4. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
5. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Mock-ups and Samples:
a. Provide Mock-ups where indicated on Drawings.
b. Color admixture samples for initial selection.
c. Multiple (3-5) 4” diameter design mix samples with color admixtures for initial selection.
d. Multiple (2-3) 12” diameter design mix samples with color admixtures for final selection.
e. Review of formwork form liner materials for board-formed and smooth concrete mock-ups prior to pouring concrete.
f. Board-formed concrete Mock-up as indicated on the Drawings.
g. Cast-in-Place concrete bench Mock-up as indicated on the Drawings.

D. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

E. Form-liner Shop Drawings: Panel/board-form layout, corner details, transitions details, joints.

F. Welding Certificates: Copies of certificates for welding procedures and personnel.

G. Quality Assurance Submittals for Integrally Insulated Cast-in-Place Concrete Wall System
a. Test Reports:
1. All reports and tests in accordance with ICC-ES Acceptance Criteria 320.
b. Manufacturer’s installation instruction

H. Thermal Calculations for Integrally Insulated Cast-in-Place Concrete Wall System
a. Thermal calculations: Provide calculations complying with ASHRAE/IES Standard 90.1 and confirming the effective thermal resistance for the concrete sandwich wall system.
b. Isothermal Planes (Series Parallel Path) Analysis:
1. To be in compliance with this standard, all wall assemblies must be calculated as provided for in the ASHRAE Handbook Fundamentals.
c. Building Envelope Performance Study:

1. ASHRAE//IESNA STANDARD 90.1-1989 - SYSTEM PERFORMANCE CRITERIA: R-value performance and the heating and cooling load adjustments for the effects of concrete mass within the building envelope.

d. Dew point calculations: Provide calculations complying with the ASHRAE Handbook of Fundamentals – Theory of Water Vapor Migration and confirming the requirements for effective moisture condensation prevention. The construction of the wall panel and the building envelope must include adequate design to prevent the formation of condensate on any panel surface and must maintain inner-wall condensation potential below <SPECIFIER> oz./day/sq.ft based on local environmental design extremes.

I. Crack mitigation: Provide details that indicate how panel wall bowing and concrete cracking will be mitigated if the concrete sandwich wall panels do not include full-thickness concrete sections or metallic connectors between the concrete wythes (surfaces).

J. Results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
1. Cementitious materials and aggregates.
2. Admixtures.
3. Curing materials.
4. Floor and slab treatments.
5. Vapor retarders.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

C. Insulation System Manufacturer’s Responsibility:
1. Provide shop drawings and detailing for fabricated concrete wall insulation system.
2. Attend pre-construction meetings and initial wall panel insulation placement to instruct in the proper installation of the wall panel system.
3. Provide quality assurance instruction and equipment for evaluation of connector installation.
4. Provide traceable and verifiable quality assurance for the connector.
   a. Listing requirements vary with product; however, all require that the manufacturers established testing and evaluation procedures must be repeatable.
      1) Material hardness per ASTM D 785
      2) Material flexural capacity per ASTM D 790

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
1. ACI 301, "Specification for Structural Concrete."
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

H. Coordinate all foundation penetrations with Architect, plumbing, mechanical, electrical contractors and local agencies.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Refer to 03 10 00 Concrete Formwork for Basis of Design.
B. Board-Formed Finished Concrete.
C. Smooth-Formed Finish Concrete: Smooth plexi-glass or fiberglass.
D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1/2 by 1/2 inch, minimum.
E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
C. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

2.03 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.04 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.
   1. Fly Ash: ASTM C 618, Class C or F.
B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
   1. Class: Moderate weathering region, but not less than 3M.
   2. Nominal Maximum Aggregate Size:
      a. 1 inch for footings and foundation walls.
      b. 3/8 inch for slabs-on-grade and concrete topping.
C. Water: Potable and complying with ASTM C 94.

2.05 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.
C. Water-Reducing Admixture: ASTM C 494, Type A.
D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
G. Integral Color Pigment Admixture:
    1. Color to match Train Station Retaining Wall.
    2. Color: Light to Medium Gray.
        a. Davis Light Gray 860.

2.06 VAPOR BARRIERS

A. Vapor Retarder: ASTM E 1745, Class A, multi-layer, extruded, HD virgin polyolefin membrane; 15 mils thick.
B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.07 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.
C. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include the following:
    1. Unpigmented Mineral Dry-Shake Floor Hardener:
        a. Non-Metallic Floor Hardener; Burke Group, LLC (The).
        b. Concolor; ChemMasters.
        c. Conshake 500; Conspec Marketing & Manufacturing Co., Inc.
        d. Quartz Tuff; Dayton Superior Corporation.
        e. Surflex; Euclid Chemical Co.
        f. Tycron; Kaufman Products, Inc.
        g. Colorhard; Lambert Corporation.
        h. Quartzplate; L&M Construction Chemicals, Inc.
        i. Maximent; Master Builders, Inc.
        j. Floor Quartz; Metalcrete Industries.
        k. Hard Top; Richmond Screw Anchor Co.
        l. Lithochrome Color Hardener; L. M. Scofield Co.
        m. Harcol; Sonneborn, Div. of ChemRex, Inc.
        n. Durag Premium; Sternson Group.
        o. Hard Top; Symons Corporation.
    2. Penetrating Liquid Floor Treatment:
        a. Titan Hard; Burke Group, LLC (The).
        b. Chemisil Plus; ChemMasters.
        c. Intraseal; Conspec Marketing & Manufacturing Co., Inc.
        d. Ashford Formula; Curecrete Chemical Co., Inc.
        e. Day-Chem Sure Hard; Dayton Superior Corporation.
        f. Euco Diamond Hard; Euclid Chemical Co.
        g. Seal Hard; L&M Construction Chemicals, Inc.
        h. Vexcon Starseal PS; Vexcon Chemicals, Inc.

2.08 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include the following:

1. Evaporation Retarder:
   a. Cimfilm; Axim Concrete Technologies.
   b. Finishing Aid Concentrate; Burke Group, LLC (The).
   c. Spray-Film; ChemMasters.
   d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
   e. Sure Film; Dayton Superior Corporation.
   f. Eucobar; Euclid Chemical Co.
   g. Vapor Aid; Kaufman Products, Inc.
   h. Lambco Skin; Lambert Corporation.
   i. E-Con; L&M Construction Chemicals, Inc.
   j. Confilm; Master Builders, Inc.
   k. Waterhold; Metalcrete Industries.
   l. Rich Film; Richmond Screw Anchor Co.
   m. SikaFilm; Sika Corporation.
   n. Finishing Aid; Symons Corporation.
   o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.
2. Clear, Waterborne, Membrane-Forming Curing Compound:
   a. AH Clear Cure WB; Anti-Hydro International, Inc.
   b. Klear Kote WB II Regular; Burke Chemicals.
   c. Safe-Cure & Seal 20; ChemMasters.
   d. High Seal; Conspec Marketing & Manufacturing Co., Inc.
   e. Safe Cure and Seal; Dayton Superior Corporation.
   f. Aqua Cure VOX; Euclid Chemical Co.
   g. Cure & Seal 309 Emulsion; Kaufman Products Inc.
   h. Glazecote Sealer-20; Lambert Corporation.
   i. Dress & Seal WB; L&M Construction Chemicals, Inc.
   j. Vocomp-20; W. R. Meadows, Inc.
   k. Metcure; Metalcrete Industries.
   l. Cure & Seal 150E; Nox-Crete Products Group, Kinsman Corporation.
   m. Rich Seal 14 percent E; Richmond Screw Anchor Co.
   n. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.
   o. Florseal W.B.; Sternson Group.
   p. Cure & Seal 14 percent E; Symons Corporation.
   q. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
   r. Hydro Seal; Unitex.
   s. Starseal 309; Vexcon Chemicals, Inc.

2.09 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Epoxy Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
   1. Types I and II, non-load bearing, Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 INSULATION SYSTEM

A. The Thermomass Building Insulation System, as supplied by Thermomass P.O. Box 950, Boone, Iowa 50036 (1-800-232-1748), consisting of both:
   1. Insulation
      a. Extruded Polystyrene Board Insulation: Complying with ASTM C 578, Type IV; with regularly spaced holes identifying connector placement locations.
   2. Structurally Non-Composite Wythe Tie Connectors
      a. Non-conductive, non-corrosive, fiber-composite connectors having a minimum tensile strength of 120,000 psi. minimum glass content of 76 percent by weight, and a coefficient of thermal expansion of 3.9×10^{-6} in/in/°F, nominal.

2.11 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
   1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): as indicated on the drawings.
   2. Maximum Slump: 4 inches plus or minus 1 inch.
   3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.
D. Slab-on-Grade and topping: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): as indicated on the drawings.
   2. Minimum Cementitious Materials Content: 540 lb/cu. yd.
   3. Maximum Slump: 4 inches plus or minus 1 inch.
E. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.
F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent Portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
G. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.
H. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

I. Maximum Water-Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals or spray from these sources.
J. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete subject to moderate sulfate exposure.
K. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
   1. Air Content: 5.5 percent for 1-1/2-inch-nominal maximum aggregate size.
   2. Air Content: 6 percent for 1-inch-nominal maximum aggregate size.
   3. Air Content: 6 percent for 3/4-inch-nominal maximum aggregate size.
L. Do not air-entrain concrete for trowel-finished interior floors. Do not allow entrapped air content to exceed 3 percent.
M. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
N. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTIONS

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth – formed finished surfaces.
   2. Class B, 1/4 inch for rough – formed finished surfaces.
D. Construct forms tight enough to prevent loss of concrete mortar.
E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
   1. Do not use rust-stained steel form-facing material.
F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Do not chamfer corners or edges of concrete.
J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 INTEGRALLY INSULATED CAST-IN-PLACE CONCRETE WALL SYSTEM R20 (THERMOMASS)

A. FABRICATION
1. Sandwich Walls:
a. Set formwork in accordance with standard assembly practices, including form ties.
b. Before installation of the insulation sheets in the forms, tape the individual sheets together per the drawing supplied by Thermomass. Install the tape on both sides of the insulation. Apply the tape only to clean, dry surfaces.
c. Install the insulation assembly in the form.
d. Install the Thermomass connectors.
a. Insert the connector in the rectangular hole in the twist-lock assembly.
b. Push the connector through the thickness of the insulation until the wing comes to rest against the face of the twist-lock assembly.
c. Using the wing for leverage, use the thumb and index finger to twist the connector in the directions indicated by the arrows on the face of the twist-lock assembly. Note that the connectors will rotate 90 degrees until internal detent in the retainer stops the rotation.
d. Continue this process for all of the connectors for a panel.
e. Using the notches on the fiber composite connectors, the sufficient connectors to the structural reinforcing bars to hold the insulation in place. Alternately, the connectors can be pre-installed and the insulation system can be pre-wired to the reinforcing cage before installation in the form.

The Thermomass Building System is designed to cover the entire area of all wall panels. Thermomass does not recommend that any full-wall thickness concrete sections be used. It is essential that plant personnel are made aware of the requirements for the system and that the installation complies with these requirements.

SAFETY CAUTION *- Since fiberglass fibers may be present on the surfaces of the Thermomass connectors, it is recommended that gloves be worn during handling and that eye contact with gloves or hands be avoided.*

f. Place the reinforcing for the remaining concrete layer and the ties to the connectors as needed. Verify that the insulation is properly located in the form and close the form.
g. During concrete placement, use accepted practice for concrete mix design and placement procedures for thin wall sections. If multiple walls intersect, start the concrete placement at the insulated walls. Ensure that the concrete is placed on both sides of the insulation with a maximum differential head of approximately one foot.
h. In installations with form-liners, maintain a positive differential head on the liner side to push the insulation and the connectors away from the liner.

3.03 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Electrical and low voltage conduit.

3.04 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
   1. Place and compact a 1/2-inch-thick layer of fine-graded granular material over granular fill.

3.05 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Zinc-Coated Reinforcement: Use galvanized steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

3.06 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting

action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
   1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect

C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
   1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
   2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.08 FINISHING FORMED SURFACES

A. A mock-up is required for any concrete surface treatment prior to performing the proposed surface treatments on existing or green concrete.

B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

C. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.

D. Rubbed Finish: Apply the following to smooth-formed finished concrete:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.09 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
   1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, Portland cement terrazzo, and other bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
   2. After floating, test surfaces for trueness with a 10 foot straight-edge. Distribute concrete as required to remove surface irregularities, and refloat repair areas to provide a continuous, smooth finish. Fill low spots with concrete containing large aggregate. Do not re-wet concrete.

D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
   2. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot-long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/8 inch.
   3. Complete surface finishing by two steel trowellings until all marks are eliminated and ringing sound as produced by the trowel is moved over the surface.
   4. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
      a. Slabs-on-grade and Topping Slabs to receive Special Floor Finish including Gymnasium Floors: Overall values of flatness, FF 50; and levelness, FF 35; with minimum local values of flatness, FF 35; and levelness, FL 24 for gymnasium floors and other specialty floor areas as required.
      b. Topping slabs except as noted above: overall values of flatness, FF 25; with minimum local values of flatness, FF 17.
      c. All other slab on grade overall values of flatness, FF 25; and levelness, FL 20; with minimum local values of flatness, FF 17; and levelness, FL 15 other.
   5. No foreign debris shall be trowelled into surface. No filling of low spots during trowelling.

E. Special Finishes: Refer to Section 033511, Concrete Polishing, Special Floor Finish.
   1. Hardened Concrete Properties:
      a. Minimum Concrete Compressive Strength: 3500 psi.
      b. Normal Weight Concrete, No light weight aggregates.
      c. Non-air entrained concrete.
   2. Placement Properties for New Concrete:
      a. Natural concrete slump of 4 1/2 inches – 5 inches, Admixtures may be used.
      b. Flatness Requirements:
         1) Overall Ff = 50
         2) Local Ff = 35
   3. Hard-Steel Trowelled (3 passes) Concrete
      a. No burn marks. Finish to ACI 302.1R, Class 5 floor
   4. Curing Options:

a. Membrane forming curing compounds (ASTM C309, Type 1, Class B, all resin, dissipating cure). Acrylic curing and sealing compounds not recommended.
b. Sheet membrane (ASTM C171) Polyethylene film not recommended.
c. Damp curing: Seven (7) day cure.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. No smooth tooling for picture frame appearance.
2. Review proposed locations with Architect prior to proceeding.

G. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

H. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply mineral dry-shake materials at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than seven days old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pours of each concrete mix. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
   a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
   a. Test two field-cured specimens at 7 days and two at 28 days.
   b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION

BUILDING CONCRETE – CONTINUED

Method of Measurement: Building Concrete for payment on a cubic yard basis. All concrete work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the contract unit price for BUILDING CONCRETE.

BUILDING METALS

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 051200
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Provide structural steel for building construction including sub-framing units that are part of the general framing system. Include anchors, bases, bearing plates, bracing, lintels when part of the structural framing and detail fittings.
   1. Prefabricated thermal break connections and isolation pads.
   2. Vent holes and weep holes with sponge baffles.
   3. Baseplates prepared with holes to allow access for conduit installation inside columns.
   4. Columns and beams prepared with penetrations to allow for passage of conduit for full concealment.
   5. Preparation for high performance coating system including zinc-rich primer for all structural steel members including plates, anchor bolts, other connectors, etc.

B. Comply with Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design AISC 1989 Edition.

C. Comply with Specification for Structural Joints Using ASTM A325 or A490 Bolts AISC approved November 13, 1985.

D. Comply with Structural Welding Code – Steel AWS D1.1.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.3 SUBMITTALS

A. Product Data for each type of product specified.

B. Samples:
   1. Hollow bolt components.
   2. Thermal break pads.
   3. Other connectors exposed to view.

C. Shop Drawings detailing fabrication of structural steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
   4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
   1. Structural steel, including chemical and physical properties.Sz
   2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
   3. Direct-tension indicators.
   4. Shear stud connectors.
   5. Shop primers.
   6. Nonshrink grout.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

C. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
   2. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
   3. AISC's "Seismic Provisions for Structural Steel Buildings."
   4. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
   5. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
   1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
   1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
   2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel and Accessories

1. W Shapes: ASTM A992 Fy=50.
2. HSS Rectangular: ASTM A500 Grade B Fy=46.
3. Pipe: ASTM A53 Grade B.
4. C, MC and L Shapes, Plates and Bars: ASTM A36.
5. Anchor Rods: ASTM F1554 Grade 36.
6. High-Strength Bolts: ASTM A325, Type 1 heavy hex.
7. Nuts: ASTM A563 heavy hex carbon-steel.
8. Washers: ASTM F436 hardened carbon-steel.
9. Welding Electrodes: Comply with AWS requirements. All welding electrodes shall be E70XX.

B. Finishing
1. Primer: Lead-free, chromate-free, non-asphaltic, rust-inhibiting primer.
   a. Refer to High Performance Coating Specification.
2. Color: White preferred over gray.
3. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
4. Shop Finishing for Steel not Exposed to View: SSPC SP-3 cleaning, Tnemec Alkyd Primer No. 10-99.
5. Shop Finishing for Steel Exposed to View: see below.

C. Grout
6. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.2 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
1. Camber structural steel members where indicated.
2. Mark and match-mark materials for field assembly.
3. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
4. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
5. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Structural Steel Exposed to View: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for exposed structural steel.
1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
2. Surface preparation: SSPC-SP6 "Commercial Blast Cleaning".
3. Finishes: Refer to High Performance Coating Specification.
4. Primer: Lead-free, chromate-free, non-asphaltic, rust-inhibiting primer compatible with intermediate and top coats.
   a. Color: White preferred over gray.

2.3 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.

2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

2.4 SHOP PRIMING

A. Shop prime steel surfaces, as outlined in Section 2.1, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed-on fireproofing.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.5 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

B. No connection shall consist of less than two ¾" diameter bolts or welds developing a minimum of 10,000 pounds unless noted otherwise.

C. All fillet welds shall be a minimum of ¼" unless noted otherwise.

D. All welds shall be visually inspected by testing agency.

E. A testing agency shall perform all inspections and testing. The structural steel fabricator and erector shall schedule all work to allow the above testing requirements to be completed.

F. Cuts, holes, openings, etc., required in structural steel members for the work of other trades shall be shown on shop drawings for structural steel and shall be made in the shop. Burning of holes or cuts in structural steel members in the field will not be permitted except by written permission from the Architect.

G. All beam to tube column connections shall be thru plate connections, unless otherwise noted.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. 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.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
   a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
D. Splice members only where indicated.
E. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
C. Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
   2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
E. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

A. Engineer will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

3.6 CLEANING

A. Touchup 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.
B. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."
D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION

SECTION 053000
STEEL DECK

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes all steel roof deck, acoustic insulation, dovetail anchor hanger system, deck closures, and other accessories.

1. Ends of deck to receive closure pieces to eliminate potential for bird roosting or nesting.

1.02 SUBMITTALS

A. Product Data: Submit copies of manufacturer's specifications and installation instructions. Include manufacturer's information as may be required to show compliance with these Specifications.

B. Shop Drawings: Submit detailed drawings showing layout of deck panels, anchorage details and every condition requiring closure panels, supplementary framing, special jointing or other accessories.

C. Calculations: Submit engineering calculations and manufacturer's data verifying that the specified deck meets the design requirements.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes and standards, except as otherwise shown or specified to be more stringent:
   1. AISI "Specification for the Design of Cold-Formed Steel Structural Members."
   2. AWS D1.3 "Structural Welding Code-Sheet Steel."
   3. SDI "Design Manual for Composite Decks, Form Decks and Roof Decks."
   4. FM "Loss Prevention Data 1-28."

B. Qualification of Welding Work:
   1. Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure."
   2. Decking welded in place is subject to inspection and testing. Remove Work found to be defective and provide new acceptable Work.

C. FM Listing: Provide metal roof deck units, which have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for "Class I" fire rated construction and "Class I-90" windstorm rating.

D. Performance Requirements:
   1. Compute the properties of metal roof deck sections on the basis of the effective design width as limited by the provisions of the AISI Specifications for deck depth and gage shown on the drawings.
   2. Design and fabricate deck for a maximum deflection of L/240 of the clear span under the total uniform dead and live loads indicated.
   3. Install and anchor roof deck units to resist gross uplift loading of 30 pounds per square foot.
      a. At overhangs, anchor to resist 45 pounds per square foot.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site at such intervals to ensure uninterrupted progress of the Work.

B. Deliver items to be incorporated in the Work of other trades in ample time to not delay that Work.

C. Keep deck panels and accessories off the ground. Protect deck panels and accessories from corrosion and deterioration.

D. Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Epic Deck
   1. Epicore 3.5 at exterior spaces.
   2. Epicore 3.5A at interior spaces.

2.02 MATERIALS

A. Steel for Galvanized Finish: ASTM A 653, Structural Quality.

B. Galvanizing: ASTM A 924, G 90
C. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces.
D. Flexible Closure Strips for Deck: Vulcanized, closed-cell, and synthetic rubber.

2.03 FABRICATION

A. General: Form deck units in lengths to span 3 or more supports with nested 2" end laps and nesting side laps. Provide deck configurations complying with SDI "Specifications and Commentary for Steel Roof Deck" of depth and flute width indicated on Drawings and as specified herein.
   1. Provide galvanized steel deck, treated to receive paint where painting is scheduled.
B. Roof Sump Pans: Fabricate from a single piece of not less than 14 gage galvanized sheet steel with level bottoms and sloping sides. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide.
C. Metal Closure Strips: Fabricate of not less than 20 gage galvanized sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends and sides of decking.
D. Mechanical Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head, self-tapping, carbon steel screws, No. 10 minimum diameter, Factory Mutual approved as a method for securing steel roof deck for Class indicated above.
E. Provide ridge and valley plates, closure plates, filler plates, sump pans, etc., necessary to perform the Work, whether shown on drawings or not.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install roof deck units and accessories in accordance with SDI and manufacturer's recommendations and final Shop Drawings, and as specified herein. Brush-off contaminates, dirt and debris.
B. Placing Deck Units:
   1. Place deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before being permanently fastened. Lap ends not less than 2".
   2. Do not stretch or contract the sidelap interlocks. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
   3. Work with structural steel erector in locating decking bundles to prevent overloading of structural members.
   4. Do not overload deck.
C. Fastening Deck Units: Unless noted otherwise, comply with the following:
   1. Permanently fasten roof deck units to steel supporting members by not less than 5/8" diameter fusion welds, or elongated welds of equal strength, not less than 12" on center at supports.
      a. Use welding washers for 22 gage and thinner deck.
   2. Comply with AWS requirements and procedures for manual shielded metal-arc welding, the appearance and quality of welds, and the methods used in correcting welding work.
   3. Lock side laps between adjacent deck units at maximum 3' on center by arc spot welds 5/8 inch minimum visible diameter or 1 inch long arc seam or fillet weld, minimum 2 per span.
   4. Do not button punch or clinch sidelaps.
D. Cutting and Fitting: Cut and fit roof deck units and accessories around other Work projecting through or adjacent to the roof decking. Provide neat, square and trim cuts.
E. Reinforcement at Openings:
   1. Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other Work.
   2. Reinforce roof decking around openings greater than 6" to less than 12" in any dimension by means of a flat steel sheet placed over the opening and fusion welded to the top

surface of the deck. Provide steel sheet of the same quality as the deck units, not less than 20 gage, and at least 12" wider and longer than the opening. Provide welds at each corner and spaced not more than 12" on center along each side. Openings greater than 12" across the ribs shall be suitably reinforced with angles. See Structural Drawings.

F. Roof Sump Pans: Place roof sump pans over openings provided in the roof decking and weld to the top-decking surface. Space welds not more than 12" on center with at least one weld at each corner. Cut opening in the bottom of the roof sump to accommodate the drain size indicated.

G. Closure Strips: Provide flexible closure strips at all open uncovered ends and edges of roof decking, and in the voids between decking and other construction.

H. Roof Insulation Support: Provide metal closure strips for the support of roof insulation where the rib openings in the top surface of roof decking occur adjacent to edges and openings. Weld closure strips into position.

3.02 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction:
   1. The Owner's testing service will inspect deck, deck fastening, and sidelap fastening.
   2. Correct deficiencies in the work that inspections and laboratory test reports have indicated to not be in compliance with requirements. The Owner may have additional tests performed, at Contractor's expense, as may be necessary to reconfirm any non-compliance of the original Work, and as may be necessary to show compliance of corrected Work.

B. Contractor’s Responsibilities
   1. Notify Agency sufficiently in advance of operations to allow for his assignment of personnel and scheduling of tests.
   2. Coordinate with Agencies’ personnel, provide access to Work.
   3. Furnish casual labor and facilities to provide access to Work to be tested to facilitate inspections and tests

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items, including:
   1. Miscellaneous steel angles, channels, plates, and bent plates.
   2. Fabrications installed as part of the exterior envelope or exterior openings are to be galvanized.

1.02 RELATED REQUIREMENTS

A. Section 099600 – High Performance Coatings.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
I. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
C. Plates: ASTM A283/A283M.
D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by intermittent welds and plastic filler.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and cold formed metal framing; galvanized finish.

2.04 FINISHES - STEEL

A. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Confirm that the ladder structure to which the ladder safety system is installed is capable of withstanding the loads applied by the system in the event of a fall.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Obtain approval prior to site cutting or making adjustments not scheduled.
D. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

BUILDING METALS – CONTINUED

Method of Measurement: Building Metals for payment on a lump sum basis. All work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for BUILDING METALS.

BUILDING FINISH CARPENTRY

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 057000
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefabricated brushed stainless steel bracket for hardwood shading fins.

1.02 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Hardwood vertical shading fins.

1.03 REFERENCE STANDARDS

A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
D. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
   1. Contractor.
   2. Architect.
   3. Owner's representative.
   4. Other subcontractors of adjacent work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, hardwood shading fins, anchors, and accessories.
C. Shop Drawings: Indicate brackets for hardwood shading fins including elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
D. Samples: Submit one (1) of each item below for each type and condition shown.
   1. Hardwood stainless steel bottom sill bracket and fasteners in actual profile and finish.
   2. All components exposed to view.
E. Manufacturer's Installation Instructions.
F. Maintenance Data: Manufacturer's instructions for care and cleaning.
G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 MOCK-UP

A. Provide mock-up of wood vertical shading fins including post supports and fasteners
B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory provided protective coverings and packaging.
B. Protect materials against damage during transit, delivery, storage, and installation at site.
C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
D. Prior to installation, store materials and components under cover, in a dry location.

1.08 WARRANTY

A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 BRUSHED STAINLESS STEEL BRACKET FOR HARDWOOD SHADING FINS

A. Prefabricated brushed stainless steel bracket: Stainless steel Type 316L with integral stainless steel anchors and fasteners at sill and top (head) conditions.
   1. Refer to Drawings for dimensions and anchors.
   2. Load Direction to Grain - Perpendicular: 17kN.
   3. Load Direction to Grain - Parallel: 36kN.

2.02 MATERIALS

A. Stainless Steel Components:
   1. ASTM A666, Type 316L.
   2. Stainless Steel Plates, Bars, Shapes and Moldings: ASTM A276/A276M, Type 3016L.
   3. Stainless Steel Finish: No. 4 Brushed finish – non-directional.

2.03 ACCESSORIES

A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as bracket components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
   2. Exposed Fasteners: Stainless Steel; flush countersunk screws or lag bolts.
B. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.
B. Verify field dimensions of locations and areas to receive work.
C. Notify Architect immediately of conditions that would prevent satisfactory installation.
D. Do not proceed with work until detrimental conditions have been corrected.
E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.
B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
C. Anchor securely to structure.
D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
E. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/16 inch per 10 feet.
B. Maximum Offset From True Alignment: 1/16 inch per 10 feet.
C. Maximum Out-of-Position: 1/16 inch per 10 feet.

3.05 CLEANING

A. Remove protective film from exposed metal surfaces.
B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.06 PROTECTION

A. Protect installed components and finishes from damage after installation until Substantial Completion.
B. Replace damaged items.

END OF SECTION

SECTION 062000

FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardwood Vertical Shading Fins
B. Hardwood Interior Bench

1.02 RELATED REQUIREMENTS

A. Section 057000 - Decorative Metal: Prefabricated metal timber post supports.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
B. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

1.04 SUBMITTALS

A. Shop Drawings: Provide overall plans, elevations, details, layout drawings including materials and grain, component profiles, adjacent brackets and fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   2. Include certification program label.
B. Samples from same stock of final finish material in grain and color as indicated below:
   1. Submit six samples of wood 2x4, 12 inch (304.8 mm) long, unsealed.
   2. Submit six samples of wood 2x4, 12 inch (304.8 mm) long, with cleaner and brightener applied.
   3. Submit six samples of wood 2x4, 12 inch (304.8 mm) long, with end grain sealer applied.
   4. Submit six samples of wood 2x4, 12 inch (304.8 mm) long, with water repellent and UV protective finish applied.
   5. Submit six samples of wood 2x4, 12 inch (304.8 mm) long, with all cleaning, brightening and sealing treatments applied.
C. Mock-ups:
   1. Hardwood vertical shading fin, full-length, finished, with stainless steel brackets.
   2. Hardwood interior bench end / corner assembly, finished, with support bracket sample installation prior to fabrication and installation of entire bench assembly.
D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
   2. Provide labels or certificates indicating that the work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Exterior Woodwork Items:
   1. Vertical shading fins.
C. Interior Woodwork Items:
   1. Bench.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.
B. Provide sustainably harvested wood, certified or labeled as specified in Section 016000 - Product Requirements.

2.03 LUMBER MATERIALS

A. Hardwood Lumber: Garapa Gold (Brazilian Ash)
   1. Premium Grade: 100% Heartwood, 100% Clear, no visible defects or sapwood streaks, graded on all faces and edges to allow for desired face selection.
   2. Kiln-dried and pre-stabilized.
   3. Profile: S4S (finished on 4 sides).
   4. Grain: Mixed fine to slightly coarse.
   5. In sizes indicated on Drawings.
   6. Color and grain to match Architect's sample (Image below).
   7. Wood cleaner & brightener: Messmers Wood & Deck Cleaner A, and Messmers Wood & Deck Brightener B.
   8. Endgrain sealer: UC Coatings; Anchorseal 2, End Sealer for Hardwood, clear finish.
   9. Water repellent and UV protective finish: Messmers UV Plus.
B. Suppliers
   1. Ironwoods: www.ironwoods.com
   2. Advantage Lumber: www.advantagelumber.com
   3. Overseas Hardwoods Company: www.OHC.net
   4. Thompson Mahogany: www.thompsonmahogany.com

2.04 FASTENINGS

A. Fasteners: Stainless steel of size and type to suit application.
   1. As indicated on the Drawings.

2.05 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.
B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.06 SHOP FINISHING

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of support structures and framing.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
B. Follow recommended acclimation practices for specified wood species and similar South American hardwood species.
C. Set and secure materials and components in place, plumb and level.
D. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.
E. Use cleaner and brightener per manufacturer's recommendations.
F. Seal end grain wood per manufacturer's recommendations.
G. Apply water repellent and UV protective finish per manufacturer's recommendations.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (3.175 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

BUILDING FINISH CARPENTRY – CONTINUED

Method of Measurement: Building Finish Carpentry for payment on a lump sum basis. All work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for BUILDING FINISH CARPENTRY.

BUILDING EXTERIOR ENVELOPE

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 054000
COLD-FORMED METAL FRAMING

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Formed steel stud exterior fascia framing.
B. Exterior wall sheathing.
C. Water-resistive barrier over sheathing.

1.02 RELATED REQUIREMENTS
A. Section 075419 - PVC Thermoplastic Single-Ply Roofing.
B. Section 076200 - Sheet Metal Flashing and Trim: Head and sill flashings.

1.03 REFERENCE STANDARDS
A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
F. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2017.
G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a (Reapproved 2015).

H. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Design data:
   4. Calculations for loadings and stresses of specially fabricated framing, signed and sealed by a professional structural engineer.
C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum ten years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
   1. ClarkDietrich Building Systems: www.clarkdietrich.com/#sle.
   2. Steel Construction Systems: www.steelconsystems.com/#sle.
   3. SCAFCO Corporation: www.scafco.com/#sle.
B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes.
   4. Live load deflection meeting the following, unless otherwise indicated:
   5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As required to meet specified performance levels.

B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch (3.42 mm), and factory punched holes and slots.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

2.05 WALL SHEATHING

A. Glass mat faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch (15.9 mm) thick, Type X - Fire Resistant.

2.06 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Water-Resistive Barrier: As specified in Section 072500.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

B. Place studs at 12 inches (300 mm) on center; not more than 2 inches (50 mm) from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.

C. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

D. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
   1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.
   2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof-mounted curbs.
B. Roofing nailers.
C. Parapet assembly.
D. Blocking for curtainwall assembly.

1.02 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
B. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
C. PS 20 - American Softwood Lumber Standard; 2015.
D. SPIB (GR) - Grading Rules; 2014.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
    1. Species: Douglas Fir-Larch, unless otherwise indicated.
    2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
    3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: S-dry or MC19.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
    1. Lumber: S4S, No. 2 or Standard Grade.
    2. Boards: Standard or No. 3.

2.03 ACCESSORIES

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
    1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
B. Fire Retardant Treatment:

1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    b. Treat rough carpentry items as indicated .
    c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 CLEANING

A. Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.
    1. Comply with applicable regulations.
    2. Do not burn scrap on project site.
    3. Do not burn scraps that have been pressure treated.
    4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at perimeter foundation wall, underside of floor slabs, and over roof deck.
B. Batt insulation and air barrier in exterior wall, ceiling, and roof construction.
C. Batt insulation for filling crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Field-applied termiticide for concrete slabs and foundations.
B. Section 075419 - PVC Thermoplastic Single-Ply Roofing: Insulation specified as part of roofing system.

1.03 REFERENCE STANDARDS

A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2018.
C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2018.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.04 SUBMITTALS

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Shop Drawings: Provide shop drawings indicating locations of each type of insulation; including details of adjacent materials, showing air barrier and vapor retarder transitions to show continuous thermal envelope and compliance with design intent.
D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Foundation, Underslab Insulation: Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
    1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
    2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
    3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
    4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
    5. Board Edges: Shiplap.
    6. Board Thickness:
        a. Under Floor Slabs (horizontal): Achieve minimum R15 - 3 inch (76 mm).

b. Within Concrete Walls (vertical): Achieve minimum R20 - 4 inch (102 mm).

7. Manufacturers:
   a. Dow Chemical Company; Styrofoam Brand Ultra SLS: www.dowbuildingsolutions.com.
   b. Kingspan Insulation LLC; GreenGuard XPS TYPE IV 25 PSI: www.trustgreenguard.com/#sle.
   c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

B. Integrally Insulated Cast-In-Place Concrete Wall System Insulation: Extruded Polystyrene (XPS) Board Insulation as recommended by system manufacturer for application: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: as recommended by system manufacturer for application.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
   5. Board Edges: As recommended by system manufacturer for application.
   6. Board Thickness:
      a. Within Concrete Walls (vertical): Achieve minimum R20 - 4 inch (102 mm).
   7. Manufacturers: As recommended by system manufacturer for application

C. Roof Insulation: Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
         3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F (24 degrees C).
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   5. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
   6. Thermal Resistance: R-value (RSI-value) of 30 (5.28).
   7. Board Edges: Square.
   8. Manufacturers:
      a. As recommended by roofing system manufacturer for application.

D. Nailbase Insulation: Extruded Polystyrene (XPS) or Expanded Polystyrene (EPS) Board Insulation Faced with Plywood: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Classifications:
   2. Top Layer Material: 7/16 inch or 5/8 inch plywood.
   3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   4. Board Size: 48 by 96 inch (1220 by 2440 mm) nominal.
   5. Board Edges: Square.
   6. Manufacturers:
      a. Atlas Roofing Corporation; ACFoam Nail Base Roof Insulation Panels: www.atlasroofing.com/#sle.
      b. Hunter Panels; _____: www.hunterpanels.com/#sle.
      c. Insulfoam InsulLam: www.insulfoam.com.

2.03 BATT INSULATION MATERIALS

A. Mineral Fiber Batt Insulation: Semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Thermal Resistance: R-value (RSI-value) of 15 (2.64).
   4. Thickness: As shown on drawings to fill cavities.
   5. Manufacturers:
      a. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com/#sle.
      b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
      c. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.

2.04 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.
   3. Temperature Resistance: Minus 40 degrees F to 212 degrees F (Minus 40 degrees C to 100 degrees C)

B. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

D. Adhesive: Gun grade, interior and exterior, and compatible with insulation and substrates; complies with ASTM C557.
   1. Application Temperature: 40 to 100 degrees F (5 to 38 degrees C) at contact surfaces.
   2. Volatile Organic Content (VOC): Less than 7 percent by weight.
   3. Type: As recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Apply adhesive to back of boards:
   1. Full bed 1/8 inch (3 mm) thick.

B. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Butt edges and ends tightly to adjacent boards and to protrusions.

C. Extend boards over expansion joints, unbonded to foundation on one side of joint.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.04 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General:
   1. See applicable roofing specification section for specific board installation requirements.

2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
3. Do not apply more insulation than can be covered with roofing in same day.

3.05 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
F. Tape seal tears or cuts in vapor retarder.
G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.06 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. In exterior wall crevices.
B. Protective cementitious coating.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
B. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
C. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
D. ASTM D1623 - Standard Test Method for Tensile And Tensile Adhesion Properties of Rigid Cellular Plastics; 2017.
E. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
I. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.04 SUBMITTALS

A. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
B. Shop Drawings: Provide shop drawings indicating locations of each type of insulation; including details of adjacent materials, showing air barrier and vapor retarder transitions to show continuous thermal envelope and compliance with design intent.
C. Certificates: Certify that products of this section meet or exceed specified requirements.
D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
E. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foamed-In-Place Insulation:
   1. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com/#sle.
   2. Henry Company: www.henry.com/#sle.
   3. Icynene-Lapolla; Icynene ProSeal: www.icynene.com/#sle.
   4. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.

2.02 MATERIALS

A. Foamed-In-Place Insulation: Low-density, flexible, open celled, water vapor permeable polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and overcoat limitations.
   2. Thermal Resistance: R-value (RSI-value) of 3.0 (0.53), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
   3. Air Permeance: 0.04 cfm/sq ft (0.2 L/second sq meter), maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf (75 Pa).
   4. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 ACCESSORIES

A. Primer: As required by insulation manufacturer.
B. Protective Coating: Cementitious type, spray applied; flame spread index (FSI) of 450 maximum and smoke developed index (SDI) of 25 maximum, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.
B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.
B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Apply to achieve a thermal resistance R-value of 13.

3.04 FIELD QUALITY CONTROL

A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 014000 - Quality Requirements.
B. Inspection will include verification of insulation and overcoat thickness and density.
C. Coordination of ABAA Tests and Inspections:
    1. Provide testing and inspection required by ABAA QAP.
    2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
    3. Cooperate with ABAA testing agency.
    4. Allow access to air barrier work areas and staging.
    5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 072500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor Retarders: Materials to make joints between exterior walls and roof water vapor resistant and air tight.
B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, joints around frames of openings in exterior walls, and parapet assembly.

1.02 RELATED REQUIREMENTS

A. Section 072100 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
B. Section 075419 - PVC Thermoplastic Single-Ply Roofing: Coverboard specified as part of roofing system.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent

surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04 REFERENCE STANDARDS

A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.
B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.
D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2017.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
G. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.05 SUBMITTALS

A. Product Data: Provide data on material characteristics.
B. Samples: Provide samples of weather barrier materials.
C. Shop Drawings: Provide drawings of special joint conditions.
D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum five years of documented experience.
   2. Approved by weather barrier system manufacturer.

1.07 MOCK-UP

A. Install vapor retarder materials in mock-ups as required to demonstrate the full exterior envelope enclosure.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Air Barrier:
   1. On outside surface of sheathing use vapor impermeable sheet, self-adhesive type.

2.02 AIR BARRIER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Sheet: ASTM D1970/D1970M.
   1. Type: Rubberized asphalt bonded to thermoplastic sheet, self-adhesive.
   2. Sheet Width: 18 inches (457 mm), and 36 inches (914 mm).
   3. Water Vapor Permeance: 0.05 perm (2.87 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.
   4. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   5. Manufacturers:
      a. Carlisle Coatings and Waterproofing, Inc; CCW-705 Air and Vapor Barrier Sheet: www.carlisleccw.com.

b. GCP Applied Technologies; Perm-A-Barrier: www.gcpat.com.
c. Henry Company; Blueskin SA: www.henry.com/#sle.
d. W.R. Meadows, Inc; Air-Shield: www.wrmeadows.com/#sle.

2.03 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.
B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
E. Self-Adhered Sheets:
   1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle-fashion to shed water and seal laps air tight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.
F. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.
G. Openings and Penetrations in Exterior Weather Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
   2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
   4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 074213.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.
B. Matching flashing and trim.
C. Closures as indicated on Drawings.
D. Exterior locations to have weep and sponge baffle.
E. Grain of panels to run in the same horizontal direction for all panels.

1.02 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Panel support framing.
B. Section 072500 - Weather Barriers: Weather barrier behind wall panel system.
C. Section 075419 - PVC Thermoplastic Single-Ply Roofing: Coverboard specified as part of roofing system.
D. Section 076200 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
E. Section 079200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
G. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2018.
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
J. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
K. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
L. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
M. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
N. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

O. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
P. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
Q. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).
R. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.
S. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.
T. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
V. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
W. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
X. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
Y. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   4. Review procedures for protection of work and other construction.
   5. Review safety precautions.

1.05 SUBMITTALS

A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.
B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.
D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system and direction of material’s natural grain.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.

5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches (1:10).
6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

E. Selection Samples: For each finish product specified, submit at least three sample color chips representing manufacturer's standard range of available colors and patterns.
   1. Sealant Color: Color to match wall panels.

F. Selection Samples: Sumbit manufacturer's printed literature identifying all standard and premium colors/finishes available for inititial color selection.

G. Selection Samples: Sumbit 3 x 5 inch samples of all manufacturer's standard and premium colors/finishes available for inititial color selection.

H. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12 inch (305 mm) square, and representing actual product in color and texture.

I. Verification Samples: Submit five samples of panel, 12 by 12 inch (304.8 by 304.8 mm) in size illustrating finish color, sheen, and texture.

J. Certificate: Certify that the work results of this section meet or exceed specified requirements.

K. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.

L. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

M. Test Report: Submit report of full-size mock-up test for NFPA 285 fire performance.

N. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

O. Designer's Qualification Statement.

P. Manufacturer's Qualification Statement.

Q. Installer's Qualification Statement.

R. Testing Agency's Qualification Statement.

S. Maintenance Data: Care of finishes and warranty requirements.

T. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
   1. With not less than ten years of documented experience.
   2. Approved by MCM sheet manufacturer.

D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum five years of documented experience.
   2. Approved by wall panel system manufacturer.

E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

F. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
   1. Locate where directed.
   2. Provide panels finished as specified.
   3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Protect finishes by applying heavy duty removable plastic film during production.
2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.
4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
1. Store in well ventilated space out of direct sunlight.
2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
3. Store at a slope to ensure positive drainage of any accumulated water.
4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.08 WARRANTY

A. Panel System Warranty: Provide joint written warranty by manufacturer and installer, agreeing to correct defects in manufacturing or installation within a five year period after Date of Substantial Completion.

B. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of thirty years:
1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material (MCM) Sheet Manufacturer Basis of Design:
1. Sobotec; SL-1000: www.sobotec.com.

B. Other Acceptable Metal Composite Material (MCM) Sheet Manufacturers:
1. 3A Composites USA; Alucobond Plus: www.alucobondusa.com/#sle.
2. Alcoa, Inc; Reynobond FR core (fire resistant): www.alcoa.com/#sle.
3. ALPOLIC Materials; ALPOLIC/fr (Fire Retardant core): www.alpolic-americas.com/#sle.
4. Citadel Architectural Products, Inc; Envelope 2000 RR: www.citadelap.com/#sle.

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
2. Provide panel jointing and weatherseal using a dry seal system.
3. Anchor panels to supporting framing without exposed fasteners.

B. Performance Requirements:
1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F (minus 29 degrees C) to 180 degrees F (82 degrees C) without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
a. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:

b. Design Wind Pressure: As specified in 30.
c. Inward Design Wind Pressure: 30 psf.
d. Outward Design Wind Pressure: 30 psf.
e. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
f. Maximum anchor deflection in any direction of 1/16 inch (1.6 mm) at connection points of framing members to anchors.

2. Air Infiltration: 0.06 cfm/sq ft (0.003 L/s/sq m) of wall area, maximum, when tested at 1.57 psf (0.075 kPa) in accordance with ASTM E283.
3. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf (0.299 kPa) minimum, after 15 minutes.
   a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
   b. Design to drain leakage and condensation to the exterior face of the wall.
4. Fire Performance: Tested in accordance with, and complying with the acceptance criteria of, NFPA 285; testing must be performed specifically for this project.
5. Building Envelope Performance: Complies with ASHRAE Std 90.1 I-P when tested as part of a building envelope assembly.

C. Panels: One inch (2.5 mm) deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
1. Reinforce corners with riveted aluminum angles.
2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
5. Metallic Finished Panels: Maintain consistent grain of MCM sheet; specifically, do not rotate sheet purely to avoid waste.
6. Fabricate panels under controlled shop conditions.
7. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
8. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.
   b. Keep plane surfaces free from warp or buckle.
   c. Keep panel surfaces free of scratches or marks caused during fabrication.
9. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
10. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets; provide means of concealed drainage with baffles and weeps for water that might accumulate in members of system.

2.03 INSTALLATION METHOD

A. Rout-and-Return System: Shop-fabricated installation system consisting of routed and formed metal composite material (MCM), mounting extrusions, mechanical fasteners, foam backer rod, silicone sealant, and accessories to provide a barrier-type system. Proper allowance shall be made for expansion and contraction of the wall panel assembly. No systems that restrict proper thermal movement, such as those utilizing single 'L' clips on all four sides, shall be permitted.

2.04 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
   1. Overall Sheet Thickness: 0.118 inch (3 mm), minimum.
   2. Face Sheet Thickness: 0.019 inches (0.50 mm), minimum.
   3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch (100 N-mm/mm) with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).
   4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   5. Flammability: Self-ignition temperature of 650 degrees F (343 degrees C) or greater, when tested in accordance with ASTM D1929.
   6. Finish: Factory finished highly polished Class I natural anodized finish; AAMA 611 AA-M12C22A41, anodic coating not less than 0.7 mils (0.018 mm) thick.
      a. Clear Anodized Aluminum Finish to match Architect's approved sample.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
   1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
   2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
   3. Stainless Steel Sheet Components: ASTM A480/A480M.
   4. Aluminum Components: ASTM B209 (ASTM B209M); or ASTM B221 (ASTM B221M).
   5. Refer to Section 054000 for additional requirements on panel support framing.

C. Flashing: Sheet aluminum; 0.040 inch (1.0 mm) thick, minimum; finish and color to match MCM sheet; refer to Section 076200 for additional requirements.

D. Anchors, Clips and Accessories: Use one of the following:
   1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
   2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
   3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.

E. Fasteners:
   1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
   2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   3. Bolts: Stainless steel.
   4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

F. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil (0.38 mm) dry film thickness per coat.

G. Joint Sealer: Provide color to match wall panels silicone sealant of type approved by MCM sheet manufacturer, and in compliance with ASTM C920.
   1. Refer to Section 079200 for additional requirements.

H. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
G. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
    1. Variation From Plane or Location: 1/2 inch in 30 feet (10 mm in 10 m) of length and up to 3/4 inch in 300 feet (20 mm in 100 m), maximum.
    2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
    3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
    4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch (0.75 mm), maximum.
I. Replace damaged products.

3.04 FIELD QUALITY CONTROL

A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 075419
PVC THERMOPLASTIC SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with PVC thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Cover Board.
D. Flashings.
E. Roofing cant strips.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood nailers and curbs.
B. Section 076200 - Sheet Metal Flashing and Trim: Counterflashings.
C. Section 077200 - Roof Accessories: Roof-mounted units; prefabricated curbs.
D. Section 079200 - Joint Sealants: Joint Sealers.
E. Section 329700 - Vegetated Roof Assemblies

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2018.
C. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
D. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2015.
E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
F. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011.
G. FM (AG) - FM Approval Guide; current edition.
H. FM DS 1-28 - Wind Design; 2016.
I. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2016.
J. NRCA (RM) - The NRCA Roofing Manual; 2018.
K. UL (FRD) - Fire Resistance Directory; Current Edition.
L. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
    1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's written information listed below.
    1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
    2. Preparation instructions and recommendations.
    3. Storage and handling requirements.
    4. Material Safety and Data Sheets for all materials to be provided.
    5. Insulation.
    6. PVC Roofing System Materials including, but not limited to:
        a. Membrane.
        b. Self-Adhering Flashing.
        c. Adhesives.

d. Seam Tape.
e. Lap Sealant.
f. Water Cut-Off Mastic.

7. Mechanical Fasteners.
8. Vapor Barrier Materials.
9. Cover Board.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.
   1. Submit shop drawings to the roofing system manufacturer for approval.
D. Samples for Selection: Submit two samples 12 by 12 inches (305 by 305 mm) in size illustrating insulation, cover board, single-ply membrane, cover strip, and colored coating.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
G. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
H. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.
I. Manufacturer's Qualification Statements and Documentation:
   1. Submit written certification that insulation to be provided is compatible with the roofing membrane to be provided.
   2. Submit written certification that all products and labor to be provided, including but, not limited to, the vapor barrier system and insulation, are covered under the Manufacturer's full system warranty.
J. Installer's Qualification Statements and Documentation:
   1. Submit written certification which confirms the Installer is currently licensed to perform the work of this section under the Illinois Roofing Industry Licensing Act.
   2. Submit written certifications that the foreman and crew members have attended installation training seminars by the roofing manufacturer.
   3. Submit written certification from the roofing system manufacturer that all appropriate warranty paper work has been submitted prior to starting the work.
   4. Submit nail pull-out test results including roof plan with test locations identified and roofing system manufacturer's letter of acceptance of pull-out results.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section:
   1. With minimum ten years documented experience.
   2. Approved by membrane manufacturer.
C. Installer Qualifications: Licensed to perform the work of this section under the Illinois Roofing Industry Licensing Act.
D. Single Source Responsibility: Provide and install products from single source.

1.07 MOCK-UP

A. Provide mock-up for evaluation of surface preparation, installation methods, and workmanship. mock-up.
B. See Section 014000 - Quality Requirements for additional requirements.
C. Locate where directed.
D. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
   1. Materials requiring fire resistance classification shall be packaged with labels attached as required by the labeling service.
B. Store products in weather protected environment, clear of ground and moisture.
C. Store rolled goods on end and handle rolled goods in manner to prevent damage to edges or ends.
D. Store liquid materials in their original undamaged containers in a clean, dry, protected location; away from direct sunlight; within the temperature range identified in manufacturer's literature.
E. Handle and store roofing materials and equipment in a manner to avoid permanent deflection of deck.
F. Protect foam insulation from direct exposure to sunlight.
G. Insulation:
   1. Store insulation on clean, raised platforms, remove manufacturer's wrappings and cover with breathable, waterproof weather protective coverings.
   2. Protect foam insulation from direct exposure to sunlight.
   3. Provide continuous protection of insulation materials against wetting and moisture absorption.
   4. Remove wet insulation materials from the project site.
   5. Once insulation becomes wet, it will be removed from the site and not used. Wet insulation which then dries shall be removed from the site, the same as wet insulation.
H. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required and confirmed by roofing manufacturer.
I. No materials shall be stored on any new or existing roofing system.

1.09 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above 95 degrees F (35 degrees C).
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 20 years after installation.
C. System Warranty: Provide manufacturer's No Dollar Limit (NDL) total roofing system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes resulting from the natural deterioration of the roofing system or from errors in the installation of the roofing system.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
D. The warranty shall start from the Date of Final Inspection by the Architect and a "PASS" warranty inspection by the Manufacturer's Representative. The date shall be established as the date the Architect and the Manufacturer's Representative inspect the work and find that all work is complete in accordance with the Contract Documents and the Manufacturer's printed instructions and forms a watertight installation.
E. The roofing installer shall notify the Architect in writing when the roof is complete for final inspection.
F. Warranty Inspection: The roofing installer shall notify the Architect in writing when the roofing system Manufacturer's Representative will conduct their warranty inspection.

1. Provide the Architect with a copy of the Warranty Inspection Checklist report prepared by the Manufacturer's Representative.

G. Vegetated Roof Assemblies Over Roofing: Provide manufacturer's twenty year, single-source "full system" warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Sika Corporation; Sika/Sarnafil G410 PVC Roofing System: www.nisuscorp.com.
B. GAF; EverGuard: www.gaf.com.
C. Carlisle; SynTec: www.carlisle-syntec.com.

2.02 ROOFING APPLICATIONS

A. PVC Membrane Roofing: One ply membrane, fully adhered, fully adhered, over cover board, over insulation, over steel roof deck.
B. Roofing Assembly Performance Requirements and Design Criteria:
   1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
      a. Calculate SRI in accordance with ASTM E1980.
      b. Field applied coating may not be used to achieve specified SRI.
   2. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.
   3. Wind Uplift:
      a. Designed to withstand wind uplift forces calculated with ASCE 7.
   4. Drainage: No standing water within 48 hours after precipitation.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, with laquer coating.
   2. Reinforcing: fiberglass scrim.
   3. Thickness: 60 mil (1.5 mm), minimum.
   4. Sheet Width: Factory fabricated into largest sheets possible.
   5. Color: To be selected by Architect from manufacturer's full color range.
   6. Membrane Properties:

	Properties	ASTM Test	Pass Test
a.	Breaking Strength (lbf/in):	D751	80 (356 N)
b.	Elongation Break (m.d./c.m.d.):	D751	250%/220%
c.	Seam Strength:	D751	Pass
d.	Retetion of Properties After Heat Aging:		
	1) Tensil Strength (% of original):	Pass 90%	
	2) Elongation (% of original):	Past 90%	
e.	Tear Resistance (lbf):	D1004	17.5 (78 N)
f.	Low Temperature Bend (-40deg F)	D2136	Pass
g.	Accelerated Weathing Test, Fluorescent Light UV Exposure (hours):		
	1) Cracking (7x mag.):	G154	None
	2) Discoloration Observed:	G154	Negligible
	3) Crazing (7x mag.):	G154	None
h.	Linear Dimensional Change (%):	D1204	-0.02
i.	Weight Change after Water Imersion (%):	D570	1.9
j.	Static Puncture Resistance (ft-lbf):	D5635	Pass 33
k.	Dynamic Puncture Resistance (ft-lbf):	D5625	Pass 7.3

B. Seaming Materials: As recommended by membrane manufacturer.
C. Flexible Flashing Material: Same material as membrane.
D. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 DECK SHEATHING AND COVER BOARDS

A. Cover Board: Polyisocyanurate (ISO) board, complying with ASTM C1289, Type II, Class 4 - Faced with coated or uncoated polymer-bonded glass fiber mat facers on both major surfaces of the core foam. This product is used at a maximum thickness of 1/2 inch (12.7 mm), and with the following characteristics:
   1. Grade and Compressive Strength: Grade 1, 80 psi (Grade 1, 551 kPa), minimum.
   2. Acceptable Products:
      a. Firestone Building Products; ISOGARD HD Cover Board: www.firestonebpco.com
      b. As recommended by Sika/Sarnafil for a complete roof warranty.
      c. As recommended by GAF for a complete roof warranty.
      d. As recommended by Carlisle Syntec for a complete roof warranty.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: As recommended by membrane manufacturer.
   1. See 072100 - Thermal Insulation.

2.06 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
   3. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) (2 mm) thick, in manufacturer's standard lengths and widths.
B. Insulation Adhesive: Two component polyurethane, expanding foam approved by roofing manufacturer.
C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (150 mm) wide; self adhering.
D. Membrane Adhesive: As recommended by membrane manufacturer.
   1. Sarnacol 2121 (water based adhesive)
E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
F. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
G. Sealants: As recommended by membrane manufacturer.
H. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.
I. Primer: Manufacturer's recommended product.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.
B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.
C. Apply manufacturer's recommended vapor retarder or temporary roof before roof installation.
D. Protect the paving, grass and building walls adjacent to hoists and kettles prior to starting work.
   1. Lap all suitable protective materials at least 6".
   2. Secure protective coverings against wind.
   3. Leave protective covering in place for duration of roofing work.

3.03 METAL DECK PREPARATION

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.05 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.06 VAPOR RETARDER AND INSULATION

A. Materials shall not be applied when moisture, in any form, such as dew, can be seen or felt on the surface to which the materials are to be applied. Prime all surfaces.
B. Attachment of Insulation: Embed each layer of insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions.
C. Do not install wet, damaged, or warped insulation boards.
D. Lay subsequent layers of insulation with joints staggered minimum 18 inch (457 mm) from joints of preceding layer.
E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
G. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.3 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
H. Provide spray foam into voids between roof curb and penetrations and insulation. Fill to top of insulation and cut flush.
I. Leading edge of tapered insulation shall be 1/2". Provide fully adhered 0" to 1/2" tapered edge strips provided for a flush transition.
J. Install two-way tapered saddles and edge strips in adhesive. Step into place and position so no cupping occurs.
K. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
L. Tapered insulation shall originate at center of the roof drain and be cut perpendicular to the drain flange at the clamping ring.
M. Do not apply more insulation and coverboard than can be completely waterproofed in the same day.

3.07 COVER BOARD INSTALLATION

A. Install in full accordance with roof system manufacturer's recommendations.
B. Lay cover board with joints staggered minimum 18 inch (457 mm) from joints of insulation below.

C. Embed cover board in adhesive in full contact. Position so that no creeping occurs. Provide weights at corners of cover board to prevent board raising off insulation.
D. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.3 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
E. Do not apply more insulation and coverboard than can be completely waterproofed in the same day.

3.08 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Apply adhesive to substrate per manufacturer's recommendations. Fully embed membrane in adhesive except in areas directly over or within 3 inches (75 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
D. Seam Welding:
    1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches (51 mm).
    2. Cover all seams with manufacturer's recommended joint covers.
    3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)
    4. Repair all deficient seams within the same day.
    5. Seal cut edges of reinforced membrane after seam probe is complete.
E. At intersections with vertical surfaces:
    1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
    2. Fully adhere flexible flashing over membrane and up to nailing strips.
    3. At front side of parapets bring membrane to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
F. Install prefabricated joint components in accordance with manufacturer's instructions.
G. Coordinate installation of roof drains and sumps and related flashings.
H. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.09 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field quality control and inspection.
B. Require site attendance of roofing material manufacturers daily during installation of the Work.

3.10 CLEANING

A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
B. Remove bituminous markings from finished surfaces.
C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
D. Repair or replace defaced or damaged finishes caused by work of this section.

3.11 PROTECTION

A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.
C. Repair any damage to existing conditions caused by work of this section.

END OF SECTION

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Miscellaneous flashings, counterflashings, and fabricated sheet metal items.
B. Reglets and accessories.
C. Scuppers.

1.02 RELATED SECTIONS
A. Section 06 10 10 - Rough Carpentry.
B. Section 07 54 19 - PVC Thermoplastic Single Ply Roofing - Fully Adhered.
C. Section 07 72 10 - Roofing Accessories.
D. Section 07 90 05 - Joint Sealers.

1.03 REFERENCES
A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
B. ASTM B32 - Standard Specification for Solder Metal.
C. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
D. ASTM D2178 - Standard Specification for Asphalt - Saturated Glass Felt Used in Roofing and Waterproofing.
E. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.
F. SMACNA (Sheet Metal and Air Conditioning Contractors National Association) - Architectural Sheet Metal Manual, Fifth Edition, 1993.

1.04 DESIGN REQUIREMENTS
A. Sheet Metal Flashings: Comply with the criteria of SMACNA "Architectural Sheet Metal Manual."

1.05 SUBMITTALS FOR REVIEW
A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
B. Product Data: Provide data on sheet metal material and prefabricated components.
C. Samples: Submit two full size samples, 12" inches long illustrating typical coping material and finish. Include continuous cleats, backer plates, cover plates and/or drive cleats.
D. Submit two manufacturer's color charts, illustrating metal finish colors.

1.06 SUBMITTALS AT PROJECT CLOSEOUT
A. Section 01 78 00 - Closeout Submittals
B. Warranty: Submit manufacturer's 20 year material warranty. Ensure forms have been completed in Owner's name and registered with manufacturer.
C. Warranty: Submit contractor's two year workmanship warranty.

1.07 QUALITY ASSURANCE
A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise noted.
B. Fabricator and Installer Qualifications: Company specializing in architectural sheet metal work with five years documented experience.

1.08 PRE-INSTALLATION MEETING
A. Convene One week before starting work of this section.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Stock material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
   1. When material is stored on the roof it must be placed on ½" minimum plywood on 1" rigid insulation. Ends of plywood shall exceed end of sheet metal goods by 2'-0".
B. Prevent contact with materials which may cause discoloration or staining.
C. All field cutting of sheet metal performed over new roofing shall be permitted only where the new roof is protected by ½" minimum plywood on 1" rigid insulation.

1.10 WARRANTY

A. Sheet Metal Contractor to issue workmanship warranty to correct defective work within a two year period after Date of Substantial Completion. Defective work includes failure of watertightness or seals and oil canning due to rupture restricted expansion/contractors or faulty workmanship.
B. Material warranty from the sheet metal manufacturer for a period of 20 years against deterioration of color, chalking and film integrity.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M,G90 zinc coating; 0.02 inch, 12 gauge core steel, shop pre- coated with PVDF (polyvinylidene fluoride) coating; color to match Architect's sample of clear anodized aluminum finish.
   1. Location: concealed from view.
B. Aluminum Sheet: ASTM B209;
   1. Thickness: 0.032, 0.040, 0.063, and 1/8-inch
      a. Location: concealed from view.
      b. Finish: clear anodized aluminum to match Architect's sample.
   2. Thickness: 1/8-inch
      a. Location: exposed to view.
      b. Finish: clear anodized aluminum to match Architect's sample.
C. Pre-Finished Aluminum Sheet: ASTM B209; 1/8 inch thick; plain finish shop pre- coated with PVDF coating; color as selected from manufacturer's standards; color to match clear anodized aluminum finish.
   1. Location: concealed from view.
D. Pre-Finished Aluminum Sheet: ASTM B209; 1/8 inch thick; clear anodized aluminum finish.
   1. Location: exposed to view.
E. Stainless Steel: ASTM A167, Type 304, soft temper, 0.030 inch thick; smooth No. 4 finish.

2.02 ACCESSORIES

A. Fasteners: Stainless steel with neopene washers.
B. Primer: Zinc molybdate type.
C. Protective Backing Paint: Zinc molybdate alkyd.
D. Sealant: Polyurethane type, manufactured by
   1. Tremco: Dymeric
   2. Sonnoborn: NPI.
   3. Sika Corporation: Sikaflex-15 LM.
E. Termination Bar: 1/8" x 1" stainless steel bar stock.
F. Solder: ASTM B32; 50/50 type.
G. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape;

2.03 FABRICATION - GENERAL

A. Fabricate continuous cleats of same materials as coping minimum 3 inches wide, interlocking with sheet a min. of ½".
   1. Drill pilot holes at 4" o.c. for attachment to wood.

2. Drill pilot holes at 6" o.c. for attachment to masonry or concrete.

B. All fastener locations will have predrilled pilot holes:
   1. Nails - 1/4" diameter @ 4" o.c.
   2. Screw Fasteners - 5/16" diameter @ 1'-0" o.c.
C. Form pieces in longest possible lengths.
D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
F. Tin edges of copper sheet to be soldered. Solder shop formed metal joints. After soldering, remove flux. Wipe and wash solder joints clean. Weather seal joints.
G. Fabricate corners from one piece with minimum 24-inch long legs; drive cleat for rigidity, seal with sealant and post finished to match adjacent finish..
H. Fabricate vertical faces with bottom edge formed outward 1/2 inch and hemmed to form drip.
I. Fabricate flashings to allow toe to extend 2 inches over roofing . Return and brake edges.
J. Fabricate gutters to rectangular profile.
K. Fabricate downspouts to profile and size indicated in the drawings.
L. Fabricate accessories in profile and size to suit gutters and downspouts.
M. Anchorage Devices: in accordance with SMACNA requirements.
N. Gutter Supports: Brackets.
O. Downspout Supports: Brackets.
P. Seal metal joints.

2.04 FACTORY FINISHING

A. Class I Natural Anodized Finish: AAMA 607.1 AA-M12C22A41; clear anodic coating not less than 0.7 mils thick.
B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.
   1. All metal materials to be delivered to the site with protective, strippable plastic film.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
C. Verify roofing termination and base flashings are in place, sealed, and secure.
   1. Verify that surfaces to receive sheet metal are smooth and clean will not impinge upon the integrity of the sheet metal.
D. Verify that all wood blocking to receive sheet metal is properly installed, anchored without warps and covered with EPDM.
E. Do not start sheet metal work until conditions relevant to sheet metal work are acceptable. Commencing of work will indicate acceptance of condition.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Lay out joints to be symmetrical about the building corners. May require more than one run be cut down to attain symmetry.
C. Paint dissimilar metals with bituminous paint to form a complete barrier.

3.03 INSTALLATION

A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with foam rod. Prime surfaces to receive sealant and seal flashings into reglets with sealant.
B. Secure flashings in place using concealed fasteners as indicated in the drawings.
C. Secure gutters and downspouts as indicated on drawings.
   1. Slope gutters 1/4 inch per foot.

2. Connect downspouts to existing storm drainage system. Make connection watertight.

D. Extreme care should be taken by Sheet Metal Contractor not to puncture the roofing membrane with metal. All metal trimmings shall be placed in an on-roof-top container.

E. Verify height of aluminum roof base flashing termination bar allows for installation of counterflashing and sealant below weep holes and throughwall flashing.

F. Continuous Cleats: Set in water cut-off mastic supplied by the Roofing Contractor or sealant, as indicated in the drawings. Secure to the surface with nail fasteners through 1/4-inch predrilled pilot holes at 4-inch on center.

G. Copings: Set continuous cleat in a full bed of water cut-off mastic supplied by the roofing contractor. Set the outside and inside corners. Secure with ¾" x ¼" stainless steel self-tapping screw fasteners with neoprene washers that are covered with sealant, following Architect's approval.
   1. Lay out coping joints symmetrical about the building corners. May require multiple cutting at 10'-0" lengths to achieve same. Install backer plates at joint locations. Nail through predrilled 1/4-inch pilot holes. Apply continuous sealant to backer plate vertical and horizontal surfaces as indicated in drawings.
   2. Run joints at +10'-0", except where the cut pieces are required for symmetry between existing corners.
   3. Secure coping to continuous cleat and pull coping over roof edge wood block. Cut 10'- 0" lengths to size to provide symmetrical placement between existing building corners.
   4. Verify coping is tight to wood blocking. Anchor with 1-¼" x ¼" stainless steel self-tapping screw fasteners with neoprene washers. Cover with sealant, following Architect's approval.
   5. Install sealant to each side of joints.
   6. Install drive cleat.

H. Fascias:
   1. Set continuous cleat in full bed of sealant or water cut-off mastic supplied by Roofing Contractor, as indicated in the drawings. Secure with nails at 4" on center through ¼" pre-drilled pilot holes.
   2. Set the outside and inside corners. Secure with nails at 4" o.c. through ¼" pre-drilled pilot holes.
   3. Lay out fascia joints symmetrical about corners. May require multiple cutting to achieve lengths of 10'-0".
   4. Apply continuous sealant to backer plate vertical and horizontal surfaces as indicated in drawings.
   5. Secure fascia to continuous cleat and nail at 4" o.c. through 1/4-inch pre-drilled pilot holes.

I. Counterflashing:
   1. Overlap the base flashing a minimum of 3".
   2. Install continuous butyl caulk tape to vertical portion of the counterflashing.
   3. Secure to the masonry with 1-¼" x 3/16" tapcons with climaseal corrosion resistive coating and neoprene washers at 1'-0" on center through 5/16" pre-drilled pilot holes. Cover with sealant following the Architect's approval.
   4. Lap counterflashing pieces 3" with bead of sealant and between pieces.
   5. Cover fastener heads with sealant after the Architect's approval.
   6. Fill sealant reservoir with sealant to shed water.
   7. Counterflashing Corner Pieces: Install pieces per Steps 1 through 6 in 3.3.I. above.

J. End Wall Flashings:
   1. Set in full bed of water cut-off mastic.
   2. Secure with screw fasteners through ¼" pre-drilled pilot holes as indicated on drawings.
   3. Coordinate installation with roofing contractor.
   4. Have the roofing contractor flash in vertical flange of end wall flashing.
   5. Install coping, or standing seam siding, over the end wall flashing by:
   6. Secure to end wall flashing vertical flange and pulling coping over the roof edge wood blocking, or, securing to the continuous clip and laying against mansard

K. Miscellaneous Flashings: Install as indicated on drawings.

1. Coordinate with interfacing contractors.

3.04 CLEANING

A. Leave material clean and free of stains.
B. Remove all sheet metal debris from roof top daily.
C. Remove all sheet metal debris from site daily.

3.05 FIELD QUALITY CONTROL

A. Provide field inspections.
B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-penetrating pedestals.

1.02 RELATED REQUIREMENTS

A. Section 075419 - PVC Thermoplastic Single Ply Roofing - Fully Adhered: Roofing materials.
B. Section 076200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
C. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

B. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
   1. Bases: High density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   4. Manufacturers as recommended by the roofing system manufacturer for compatibility to maintain warranty of roofing system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
C. ASTM C834 - Standard Specification for Latex Sealants; 2017.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
    1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
    2. List of backing materials approved for use with the specific product.
    3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
    4. Substrates the product should not be used on.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
    1. Adhesion Testing: In accordance with ASTM C794.
    2. Compatibility Testing: In accordance with ASTM C1087.
    3. Allow sufficient time for testing to avoid delaying the work.
    4. Deliver to manufacturer sufficient samples for testing.
    5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
    6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

A. Replace defective materials within a five year period after Date of Substantial Completion.
B. Warranty: Include coverage for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Bostik Inc: www.bostik-us.com/#sle.
   2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
   4. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
   5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

2.03 NONSAG JOINT SEALANTS

A. Type S1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Applications:
      a. Exterior wall and control joints.
      b. Joints between door and window frames and adjacent masonry.
      c. Other exterior joints where no sealant is specified.
   2. Movement Capability: 25%, minimum.
   3. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   4. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   5. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   6. Color: To be selected by Architect from manufacturer's standard range.
   7. Cure Type: Single-component, neutral moisture curing.
   8. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
   9. Manufacturers:

a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.

B. Type S2 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Applications:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and adjacent walls.
      c. Other interior joints where no other sealant is identified.
   2. Color: Suitable for painting, Type OP (opaque).
   3. Manufacturers:
      a. Sherwin-Williams Company; Powerhouse Siliconized Acrylic Latex Sealant: www.sherwin-williams.com/#sle.
      b. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
      c. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
      d. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
      e. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.04 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 101401
BUILDING-MOUNTED EXTERIOR SIGNAGE

Flat Cut Metal - Letters & Logos

Part I – General

1.1 Scope

A. Furnish letters and hardware necessary to install Flat Cut Metal letters and logos, shown on drawings and herein specified.

1.2 Submittals

A. Manufacturer's illustrated product literature and specifications.
B. Shop drawings including installation details and anchor templates.
C. Samples
   1. (6) 6"x6" paint samples for initial and final selection.
   2. (3) 6"x6" finish samples for each material.
   3. (1) full-size sample of a character for each type of sign.
   4. (3) of each accessory, anchors and fasteners.
D. Mock-up: As indicated in the Drawings.
E. Installation instructions.
F. Warranty.

1.3 Quality Assurance

A. Manufacturer to have a minimum of 20 years experience in manufacturing letters.
B. All letters to be manufactured by one manufacturer.

Part II – Products

2.1 Acceptable Manufacturer or Manufacturer's Representative

A. Basis of Design: Gemini Incorporated: www.geminisignproducts.com
B. Impact Signs, Inc.: www.impactsigns.com
C. Inpro: www.inprocorp.com
D. MTH Industries: www.mthindustries.com

2.2 Materials (Metal Alloy Options & Gauge)
A. Aluminum - 5052 Alloy (1/8", ¼", 3/8", ½", ¾", 1"thick)

2.3 General Construction
A. Cutting
1. Flat Cut: Laser or Waterjet cut (based on Metal, Gauge and Product), using computer-guided equipment.
2. MINI Letters: Precision CNC cut. (under 3"high), using computer guided equipment.
3. Premium Finish (over 3"high): Hand sanded or polished, face-return combinations.

2.4 Finishes (meeting ASTM G4A specifications)
1. Aluminum
   1. Brushed face & straight returns, 5052 Alloy, #4 non-directional grain. Clear low-gloss powder coated, baked.
   2. Painted face & returns (standard or custom colors), 5052 Alloy, sprayed with acrylic polyurethane (1.75 +/– .25 mils thick) gloss, semi-gloss, satin or matte sheen, baked.
   3. Clear Anodized, 5052 Alloy, bead-blasted returns, process complies with AA-M33-C22-A31 Architectural Class II sulfuric anodizing process with coating thickness of 0.4 mil to 0.7 mil., no clear coat.

2.5 Mounting Hardware & Options
A. Blind stud standard, available aligned for Brick, Block, or Rail.
B. Letters under 15", drilled & tapped for 10-24 threaded studs. Thin strokes, 6-32 or 4-40 threaded studs.
C. Metal spacer sleeves as indicated on the Drawings.

2.6 Fabrication
A. Letters shall be made of materials as indicated on the Drawings.
B. Letter style and height as indicated on the Drawings.
C. Letter finish as indicated on the Drawings.
D. Mounting as indicated on the Drawings. A mounting template designating stud locations is required for mounting all letters.
E. Certifications: Gemini flat cut metal products are certified for the Buy American Program, the Made in America requirements of the American Recovery Act of 2009, the EU REACH program, and qualify jobs for LEED program points.

Part III – Execution
3.1 Installation
A. A qualified installer shall install Flat Cut Metal letters and logos. Additional structural support may be required on larger and heavier Letters & Logos. Stronger adhesives, such as Epoxy may be required to install with studs on heavier products.
B. Install in accordance with manufacturer's instructions.
C. Install neatly, with horizontal edges level.
D. Protect from damage until substantial Completion; replace damaged items.

3.2 Warranty
A. Letters should be guaranteed for twenty-five (25) years against defects.

3.3 Maintenance
A. Cleaning as needed per manufacturer recommendations.

Cast Metal – Letters & Logos Specifications

Part I – General

1.1 Scope

A. Furnish letters and hardware necessary to install cast letters/logos, shown on drawings and herein specified.

1. Backing as indicated on Drawings to prevent nesting of birds or insects.

1.2 Submittals

A. Manufacturer's illustrated product literature and specifications.
B. Shop drawings including installation details and anchor templates.
C. Samples
   1. (6) 6"x6" paint samples for initial and final selection.
   2. (3) 6"x6" finish samples for each material.
   3. (1) full-size sample of a character for each type of sign.
   4. (3) of each accessory, anchors and fasteners.
D. Mock-up: As indicated in the Drawings.
E. Installation instructions
F. Warranty.

1.3 Quality Assurance

A. Manufacturer to have a minimum of 20 years experience in manufacturing Letters/Logos.
B. All letters to be manufactured by one manufacturer.

Part II – Products

2.1 Acceptable Manufacturer or Manufacturer's Representative

A. Basis of Design: Gemini Incorporated: www.geminisignproducts.com
B. Impact Signs, Inc.: www.impactsigns.com
C. Inpro: www.inprocorp.com
D. MTH Industries: www.mthindustries.com

2.2 Materials (Metal Alloys)

A. Aluminum – 514 Alloy.

2.3 Finishes (meeting ASTM G4A specifications)

B. Aluminum (Alloy #514)

1. Brushed face & straight returns, #4 non-directional grain. Clear low-gloss powder coated, baked.
2. Painted: custom color, belt sanded faces & returns, liquid sprayed with a 2-part hardened polyurethane, baked.
3. Clear Anodized: belt sanded faces and returns, anodized to meet A31 Aluminum Architectural Class II anodized finish (.4-.7 mil), no clear coat.

2.4 General Construction

A. Gemini cast Aluminum Letters & Logos - in one of multiple company foundries.
B. Cast Letters are sand cast from standard pattern styles or custom produced per customer's vectorized art files.
C. Cast Letters are hand finished per order, per customer specifications.

2.5 Mounting Hardware & Options

A. Blind stud standard, available aligned for Brick, Block, Rail.
B. Letters under 15", drilled & tapped for 10-24 studs. Thin strokes, 6-32 or 4-40 studs.
C. Metal spacer sleeves as indicated on the Drawings.

2.6 Manufacture

A. Letters shall be made of materials as indicated on the Drawings.
B. Letter style and height as indicated on the Drawings.
C. Letter finish as indicated on the Drawings.
D. Mounting as indicated on the Drawings. A mounting template designating stud locations is required for mounting all letters.

Part III – Execution
3.1 Installation
A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.
C. Protect from damage until substantial Completion; replace damaged items.
3.2 Warranty
A. Letters should be guaranteed for twenty-five (25) years against defects.
3.3 Maintenance
A. Cleaning of Letters/Logos as needed, per manufacturer's recommendations.

END OF SECTION

SECTION 32 97 00
VEGETATED ROOF ASSEMBLIES

PART 1 - GENERAL
1.1 SUMMARY
A. Section Includes:
1. Providing equipment, materials, tools, and labor to install vegetated roof modules.
2. Providing vegetated roof modules including growth media and plants.
3. Edge treatments, custom shaping of modules, and installing slip sheet/root barrier.

1.2 SUBMITTALS
A. Submit list of sources for plant material to be provided.
B. Product data for vegetated roofing systems.
C. Planting mix design indicating species.
D. Samples:
1. Typical vegetated roofing module, unplanted.
2. Soil media, 1 gallon, in plastic ziploc bag
3. Edging material, 3 feet long with typical fasteners
E. Shop Drawings: Indicating layout of modules and square footage.
F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
G. Special Vegetation Warranty: Submit two (2) signed copies of vegetation warranty of health plant growth for two (2) full growing seasons after final acceptance: 1 year – 50% minimum coverage; 2-years – 80 % minimum coverage.
H. Maintenance instructions for inclusion into owner's manuals.

1.3 QUALITY ASSURANCE
A. No deviation shall be made from this specification. Contractor and installer assume liability for any deviations from specification.
B. Only certified installer personnel shall complete all work.
C. Prior to installing vegetated roof modules, the following procedures shall be conducted:
1. The building Architect shall verify that the roof is properly designed and constructed to adequately support the load of the vegetated roof system.
2. The roof shall be tested for water tightness prior to installation of vegetated roof system.
3. Slipsheet/root barrier shall be properly installed, seams overlapped and bonded, in accord with architect's and manufacturer's specifications.

4. The roof shall be inspected and determined ready to accept the vegetated roof modules by a Technical Representative of the Installer.

D. Once the vegetated roof module installation is completed, an inspection shall be conducted by a Technical Representative of the installer to verify that the vegetated roof modules have been installed tight against each other, in straight rows, corners aligned, properly oriented, and tight against the edging.

1.4 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section. Review vegetated roof standardized procedures with supervisory staff.

1.5 DELIVERY, STORAGE, HANDLING, PROTECTION

A. Vegetated roof modules shall be:
   1. Delivered in good condition free from shipping damage.
   2. Kept out of the sun if plastic wrapped to prevent overheating.
   3. Installed on the roof top within 4 hours of delivery.
   4. Handled on the job-site to prevent damage to the modules themselves and all roofing components.

B. Vegetated roof modules shall be conveyed to roof surface with equipment designed to carry the collective load of the vegetated roof modules and transport

C. Never exceed the load capacity of the roof deck when placing vegetated roof modules on the roof.

D. Roof Protection
   1. During installation, protect the roof deck and membranes with appropriate materials such as plywood sheeting.
   2. Never scrape or puncture slip sheet or membranes.
   3. Keep roof surfaces free of soil, grit, or debris at all times with broom. Vegetated roof modules shall not be set on top of soil, dirt or grit.

E. Transport carts shall:
   1. Have pneumatic tires.
   2. Be wheeled about only upon protective plywood sheeting.
   3. Be loaded so as not to exceed weight capacity of roof deck.

PART 2 - PRODUCTS

2.1 MODULES

1. Vegetated roofing module shall consist of a modular unit filled with engineered soil materials.
2. Modules shall be provided vegetated upon installation with the plant species indicated on the plans.

B. Modules shall have the following specifications:
   1. Sidewalls: 150 mil thick 100% recycled polyethylene with UV inhibitors and stabilizers.
   2. Dimensions: 3-1/4 inches tall (Total media depth must be 6”).
   3. Saturated weight with mature vegetation: approximately 40-50 lb. per square ft. (6” system).

2.2 GROWING MEDIUM

A. Growing medium shall be an engineered blend of inorganic and organic components based upon German FLL granulometric guidelines modified so as to contain ecologically sustainable levels of organic content.

2.3 PLANTS

A. Vegetated roof module shall be filled with plants in mix as indicated on the plans and as supplied by the manufacturer.

B. Plants shall be grown to a minimum of 95% soil coverage prior to installation.

C. Refer to contract drawings for additional information about plant mixes.

2.4 ACCESSORIES

A. Slip Sheet
   1. Non-woven geotextile sheeting made from 100% post consumer polyester material
   2. Weight: 6.0 ounces/square yard
   3. Thickness: 120 mils
   4. UV Resistance: 70 min.

B. Edging:
   1. L-shaped extruded aluminum edging with perforations for drainage as specified by vegetated roof module manufacturer.
   2. Edging shall allow for adequate drainage via sufficient drain perforations.
   3. Edging is required around all perimeter and exposed edges of vegetated roof modules and as shown on the Drawings.
   4. Edging is required at edge of all cut modules.
   5. Edging shall be attached to modules, using 10-24 x 1" wafer head self-tapping screws in gray spex finish.

PART 3 - EXECUTION

3.1 INSPECTION

A. Vegetated roof installation must be conducted by certified installer.

3.2 PREPARATION OF ROOF SURFACE

A. Contractor shall install slip sheet/root barrier in accordance with manufacturer's recommendations.
B. All surfaces shall be smooth, free of debris, soil, and grit prior to placing modules. All materials shall be tested water tight and free draining prior to module placement.
C. All surfaces shall be maintained clean and free of debris, soil, and grit during installation process.

3.3 INSTALLATION SEASON

A. Vegetated roof module installation shall be conducted when plants are:
   1. Properly adapted and acclimatized to local weather conditions.
   2. When weather is above 35° F and there is no ice on the roof and planting soil is unfrozen.

3.4 INSTALLING VEGETATED ROOF MODULES

A. Vegetated roof module installation shall follow behind installation of slip sheet/root barrier, irrigation system, and edging.
B. Vegetated roof module installation to be conducted in strict accordance with manufacturer's installation guidelines. Rows shall be straight, modules to be tight against each other with edges overlapping and arranged in proper directional orientation.
C. Vegetated roof module installation shall be conducted in accordance with green roof design indicated on the plans.
D. Vegetated roof modules shall be placed directly on top of appropriate slip sheet.
E. It is recommended that any custom cutting/fitting be oriented on the high side (top), or sides of the roof. It is recommended that the cut side of the module be set tight against the edging or toward the side of an intact module so as to prevent soil spillage. If custom cutting must be done on the low, draining, side of the roof, it is imperative that no filter cloth be inserted as it could impede drainage. It is best to orient the cut side against another module, facing upstream.
F. After installation, modules shall be immediately watered so as to thoroughly moisten the media from top to bottom. Water shall be of suitable quality for plant growth and irrigation system or hoses and sprinklers may be used for such purpose.

3.5 MAINTENANCE

A. Documentation: Record all green roof maintenance events. Include name of person, date and activity.
   1. If fertilizer, record type and amount applied per 1000sf
   2. If soil test, record lab
   3. If irrigation, record duration and quantity

B. Annual Maintenance
   1. Soil Testing and Fertilization. During April 1 to 15 of each year, administer an annual soil test for PH and fertility levels.
      a. Maintain pH in the range of 6.5 to 8.0. In the event that pH is outside of the 6.5 to 8.0 range, consult vegetated roof module supplier for the appropriate amendment.
      b. Maintain fertility in the normal range using a typical field soil fertility test as provided by A&L labs. When indicated, apply a single springtime application of Nutricote 14 14 14, Type 180 (180 day release period), at 20lbs per 1000 sf. Follow the Nutricote labeled directions for application rate, which take priority over any recommendations listed here. Runoff potential does exist and should be evaluated by the applicator in accord with the site specifics; the greater the runoff sensitivity, the lower the application rate. All applications of fertilizer are the sole responsibility of the applicator.

C. Irrigation
   1. Contractor shall water the new vegetated roof modules to ensure proper growth through the maintenance and warranty period.
   2. Contractor shall monitor the moisture content of the vegetated roof modules throughout the roof to ensure that the moisture content is properly maintained.

D. Inspections and Plant Care Protocol
   1. Conduct the following every 2 weeks (twice per month) During the entire spring through fall growing season:
      a. Conduct hand weeding during the twice monthly inspection. Pull all weeds, never allow any weed to flower, set seed and complete its life cycle. Weeding should be conducted spring through fall in areas where the roof becomes frozen and snow-covered in winter. In warmer climates, it should be continued year round.
      b. The interval may be adjusted in accord with seasonal variations in weed growth, but the interval should never exceed 2 weeks or be long enough to allow for weeds to flower and set seed. Never allow woody plants to establish in a green roof system as their root systems are extensive and can damage roof membranes.
      c. Herbicides, whether pre-emergent or post-emergent, are not recommended as they are not healthy for the environment and can contaminate runoff. A need for pre-emergent herbicides is a sign of weeding too infrequently.
   2. Displaced Soil - Any displaced soil must be immediately replaced.
   3. Drainage Inspection - Roof drains must be cleared of any debris, pebbles, leaves, etc. during the twice monthly inspection to keep drains flowing freely.
   4. Debris / Trash Removal - Remove immediately debris or trash during twice monthly inspection. During fall and spring, rake vegetated roof planting clean of any matted tree leaves to prevent smothering.
   5. Pesticides - Pesticide use is discouraged and should always be considered secondary to cultural and biological control measures, as pesticides can get into runoff water and cause environmental damage. Pesticide use should only be conducted by qualified and licensed applicators, and on an “as needed” basis. All applications of pesticides are the sole responsibility of the applicator.
   6. Optional Mowing - If desired, around April 1, mow the green roof to a height of 2” or less. The clippings should stay on the roof. Do not bag and remove. Use protective equipment.
   7. Wintertime - Avoid applying salt and other deicing agents to vegetated roof module plantings. Avoid walking on frozen plants and roof surfaces.

E. Apply slow release fertilizer as needed in accord with manufacturer's directions. Avoid runoff into sensitive areas.

3.6 ACCEPTANCE

A. Conduct post installation inspection to determine acceptance of modules. Inspection to be made by General Contractor's Representative and Owner's Representative upon General Contractor's request; five working days notice required.
B. Upon acceptance, Owner assumes responsibility for module/plant maintenance.

3.7 CLEAN UP

A. Throughout installation, keep all work surfaces clean and free of grit, dirt, or debris. Use broom not blower, do not sweep soil under modules or slip sheet. Following installation, remove all excess materials and tools from job site. Ensure that any damage that occurs as a result of installation is appropriately and immediately repaired.

END OF SECTION

BUILDING EXTERIOR ENVELOPE – CONTINUED

Method of Measurement: Building Exterior Envelope for payment on a lump sum basis. All work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for BUILDING EXTERIOR ENVELOPE.

BUILDING OPENINGS

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL
1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
C. ASTM C834 - Standard Specification for Latex Sealants; 2017.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver to manufacturer sufficient samples for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

A. Replace defective materials within a five year period after Date of Substantial Completion.
B. Warranty: Include coverage for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Bostik Inc: www.bostik-us.com/#sle.
   2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
   4. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
   5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.
B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

2.03 NONSAG JOINT SEALANTS

A. Type S1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Applications:
      a. Exterior wall and control joints.
      b. Joints between door and window frames and adjacent masonry.
      c. Other exterior joints where no sealant is specified.
   2. Movement Capability: 25%, minimum.
   3. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   4. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   5. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   6. Color: To be selected by Architect from manufacturer's standard range.
   7. Cure Type: Single-component, neutral moisture curing.
   8. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
   9. Manufacturers:
      a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.
B. Type S2 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Applications:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and adjacent walls.
      c. Other interior joints where no other sealant is identified.
   2. Color: Suitable for painting, Type OP (opaque).
   3. Manufacturers:
      a. Sherwin-Williams Company; Powerhouse Siliconized Acrylic Latex Sealant: www.sherwin-williams.com/#sle.

b. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
c. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
d. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
e. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.04 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.
D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum doors, frames, sub-frames, and associated hardware.
B. Weatherstripping and sweeps.

1.02 RELATED REQUIREMENTS

A. Section 084413 - Glazed Aluminum Curtain Walls: Framing system for aluminum entrance doors specified herein.
B. Section 087100 - Door Hardware: Hardware items other than specified in this section.
C. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
C. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least ten years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
D. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront Doors:
   1. Basis of Design - Exterior, Heavy Duty, Thermally Isolated Swing Doors:
      a. EFCO Corporation; Series D502: www.efco.com.
   2. For any product not identified as "Basis of Design", submit information as specified for substitutions for review and approval prior to submittals.
   3. Other Manufacturers:
      a. Kawneer North America: www.kawneer.com.
      b. Oldcastle Building Envelope: www.oldcastlebe.com.
      c. Wausau Apogee: www.wausauwindows.com.

2.02 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
B. Glazing: As specified in Section 088000.
C. Swing Doors for Exterior Glazed Aluminum Curtain Walls: Glazed aluminum.
   1. Thickness: 2 inches (50 mm).
   2. Top Rail: 5 inches (100 mm) wide.
   3. Vertical Stiles: 5 inches (100 mm) wide.
   4. Bottom Rail: 10 inches (165 mm) wide.
   5. Glazing Stops: Square.
   6. Glazing Thickness: 1 inch (25.4 mm).
   7. Finish: Same as curtain wall.
   8. Construction: Shear block construction, bracket reinforced and plug welded corners.
   9. Wall Thickness: 0.188 inches (4.7 mm), minimum.
   10. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
   1. Aluminum: 6063-T6 alloy and temper.
B. Fasteners: Stainless steel.

2.04 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.05 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.
B. Other Door Hardware: As specified in Section 087100.
C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
E. Threshold: Extruded aluminum, thermally broken, one piece per door opening, ribbed surface; provide on all exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Set thresholds in bed of sealant and secure.
J. Install hardware using templates provided.
   1. See Section 087100 for hardware installation requirements.
K. Install glass and infill panels in accordance with Section 088000, using glazing method required to achieve performance criteria.
L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 084413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL
1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and metal infill panels.

1.02 RELATED REQUIREMENTS

A. Section 051200 - Structural Steel Framing: Steel attachment members.
B. Section 088000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
L. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
M. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
N. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
O. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018.
P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
Q. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
R. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
S. ASTM E413 - Classification for Rating Sound Insulation; 2016.

T. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
D. Samples: Submit two mullion cap samples 2 by 12 inches (50 by 50 mm) in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.
E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
F. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Qualifications: Provide shop drawings for curtain wall and its structural support framing components under direct supervision of an Illinois licensed Professional Structural Engineer.
B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years of documented experience.
C. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. Correct defective Work within a three year period after Date of Substantial Completion.
B. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
C. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Walls:
    1. Basis of Design:
        a. EFCO Corporation; System 5600 Thermal Curtain Wall with Duracast Fiberglass Pressure Plate: www.efco.com.

2. Other Acceptable Manufacturers:
    a. Kawneer North America: www.kawneer.com/#sle.
    b. Oldcastle Building Envelope: www.oldcastlebe.com/#sle.
    c. Wausau Apogee: www.wausauwindows.com

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
    1. Outside glazed, with pressure plate and mullion cover.
    2. Fabrication Method: Either shop/factory or field fabricated system.
    3. Glazing Method: Field glazed system.
    4. Finish: Class I natural anodized.
        a. Factory finish surfaces that will be exposed in completed assemblies.
        b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
    5. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
    6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
    7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
    8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
    1. Design Wind Loads: Comply with the following:
        a. Positive Design Wind Load: 30 lbf/sq ft (960 Pa).
        b. Negative Design Wind Load: -30 lbf/sq ft (-960 Pa).
        c. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
        d. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
    2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
        a. Meet design displacement of 0.010 x the greater adjacent story height and ultimate displacement of 1.5 x the design displacement.
    3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
        a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
        b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
        c. Movement of curtain wall relative to perimeter framing.
        d. Deflection of structural support framing, under permanent and dynamic loads.
C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
    1. Test Pressure Differential: 15 psf (480 Pa).
D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.
E. Thermal Performance Requirements:

1. Condensation Resistance Factor of Framing: 74, minimum, measured in accordance with AAMA 1503.
2. Condensation Resistance (CR) of Framing: 62, minimum, measured in accordance with NFRC 500-2010.
3. Overall U-value Including Glazing: 0.37 Btu/(hr sq ft deg F) (2.10 W/(sq m K)), maximum.

F. Acoustical Performance Requirements:
1. Sound Attenuation: STC of 29, minimum, from exterior to interior.
2. Test Method: ASTM E90, with calculation in accordance with ASTM E413.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Cross-Section: 2-1/4 by 6 inch (57 by 152 mm) nominal dimension.

B. Glazing: As specified in Section 088000.

C. Aluminum Entrance Doors: As specified in Section 084313 - Aluminum-Framed Storefronts.

2.04 MATERIALS

A. Aluminum: 6063-T6 alloy and temper.
1. Extruded Aluminum: ASTM B221 (ASTM B221M).
2. Sheet Aluminum: ASTM B209 (ASTM B209M).
3. Wall Thickness: 0.093 inches (2.3 mm) to 0.125 inches (3 mm), minimum.

B. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

C. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

D. Concealed Flashings: Stainless steel, 26 gage, 0.0187 inch (0.48 mm) minimum thickness.

E. Pressure Plates: Fiberglass composite.
1. Flexural Strength: 82 ksi (565 Mpa) minimum along the lineal's major axis.
2. Thermal Conductivty: 2 BTU-in/hr-ft²-°F (0.289 W/m²•K) maximum.

F. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

G. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

I. Glazing Accessories: As specified in Section 088000.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.
1. Frame components shall be mechanically fastened by means of extruded aluminum shear blocks attached to vertical mullions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Install louvers and associated flashings.
H. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 088000, using exterior dry glazing method.
I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.04 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.
B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for aluminum doors.

1.02 RELATED REQUIREMENTS

A. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
B. Section 084413 - Glazed Aluminum Curtain Walls: Door hardware, except cylinders.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. BHMA A156.1 - American National Standard for Butts and Hinges; 2013.
C. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2011.
D. BHMA A156.3 - American National Standard for Exit Devices; 2014.
E. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
F. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
G. BHMA A156.6 - American National Standard for Architectural Door Trim; 2010.
H. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2014.
I. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.
J. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2012.
K. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.
L. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
M. BHMA A156.21 - American National Standard for Thresholds; 2014.
N. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012.
O. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.

P. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems; 2013.
Q. BHMA A156.30 - American National Standard for High Security Cylinders; 2014.
R. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
S. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.
T. IBC 2015 - International Building Code.
U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
V. NFPA 101 - Life Safety Code; 2015.
W. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. The Installer's Architectural Hardware Consultant (AHC) is to visit the project site to become familiar with the project and verify existing conditions prior to preparing the submittals specified herein.
B. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on including, but not limited to, internal reinforcing required for hardware.
C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section to coordinate the work and review special installation requirements. Attendance is required by affected installers.
D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
E. Keying Requirements Meeting:
    1. The Installer's Architectural Hardware Consultant is to convene a meeting with the Owner to review keying requirements.
    2. Attendance Required:
        a. Owner.
        b. Installer's Architectural Hardware Consultant (AHC).
        c. Hardware Installer.
    3. Agenda:
    4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
    5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
    6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
B. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
    1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
    2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
    3. List groups and suffixes in proper sequence.
    4. Provide complete description for each door listed.
    5. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
    6. Include account of abbreviations and symbols used in schedule.
C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1. Submit manufacturer's parts lists and templates.
2. Bitting List: List of combinations as furnished.

E. Keying Schedule:
1. Submit electronic copies of the Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

F. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
1. Lock Cylinders: Two for each master keyed group.
2. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least ten years of documented experience.

C. Supplier Qualifications:
1. Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.
2. Company with at least ten years of documented experience.
3. Company with a permanent office and shop located within 30 miles of the project site.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 HARDWARE SUPPLIERS

A. Edward Stauber Wholesale Hardware, Inc.
1. Address:2105 Northwestern Avenue, Waukegan, Illinois 60087.
2. Phone: (847) 623-7740.

B. LaForce, Inc.

C. Classic Hardware + Door.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.

D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to the end of this section for a listing of hardware sets.

E. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
   a. Aluminum fasteners are not permitted.
   b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
   a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction.
5. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
6. Fire-Rated Applications: Comply with NFPA 80.
   a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
   b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
7. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.03 KEYING

A. Keying system shall be integrated with the existing building keying system.
B. The Harware Supplier shall meet with the Owner to finalize the following:
   1. Lockset Functions.
   2. Keying requirements for all locks and cylinders to be provided.
   3. Lever handle design.
   4. Finishes for all hardware.
C. Locks and cylinders are to be keyed per the Owner's instructions.
D. The Hardware Supplier shall deliver permanent cores with identifying tags directly to the Owner by secure shipment including the approved hardware schedule submittal. Provide a letter of transmittal documenting the contents of the shipment. The person receiving the permanent keys shall sign for the shipment to confirm receipt. The letter of transmittal and proof of receipt of shipment shall be copied to the Architect and Construction Manager.

2.04 HINGES

A. Manufacturers:
   1. Hager Companies: www.hagerco.com/#sle.
   2. Substitutions: Not permitted.
B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Continuous Hinges: Comply with BHMA A156.26.
   2. Provide hinges on every swinging door.

2.05 EXIT DEVICES

A. Manufacturers:
   1. Von Duprin, an Allegion brand; Series 88 Mortise Exit Device: www.allegion.com/us/#sle.
   2. Substitutions: Not permitted.
B. Exit Devices: Comply with BHMA A156.3, Grade 1.
   1. Lever style L05 design to match lockset trim.
   2. Provide hex key dogging.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Options: Provide reinforced crossbar.

2.06 NOT USED

2.07 CYLINDRICAL LOCKS

A. Manufacturers:
   1. Schlage, an Allegion brand: www.allegion.com/us/#sle.
   2. Substitutions: Not permitted.
B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch (54 mm) diameter.
   2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.
   5. Provide a lock for each door, unless otherwise indicated that lock is not required.
   6. Provide an office lockset for swinging door where hardware set is not indicated.
   7. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.
C. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide high security mechanical type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.30 or UL 437 at locations indicated.
   2. Provide cams and/or tailpieces as required for locking devices.
   3. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.
D. Keying: Cores shall be coordinated with the Owner's locksmith for final keying.

2.08 MORTISE LOCKS

A. Manufacturers:
   1. Schlage, an Allegion brand: www.allegion.com/us/#sle.
   2. Substitutions: Not permitted.
B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
   1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
   2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.
C. Electronic timed locking feature with required power supply source.
D. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide high security mechanical type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.30 or UL 437 at locations indicated.
   2. Provide cams and/or tailpieces as required for locking devices.
   3. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.
E. Keying: Cores shall be coordinated with the Owner's locksmith for final keying.

2.09 NOT USED

2.10 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Substitutions: Not permitted.
B. Manufacturers; Concealed - Overhead:
   1. LCN, an Allegion brand; 2030 Series: www.allegion.com/us/#sle.
   2. Substitutions: Not permitted.
C. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Concealed, overhead mounted.

2. Provide door closer on each exterior door.
3. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
4. At outswinging exterior doors, mount closer on interior side of door.

2.11 PROTECTION PLATES

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. Ives, an Allegion brand: www.allegion.com/us/#sle.
   4. Substitutions: Not permitted.
B. Protection Plates: Comply with BHMA A156.6.
C. Metal Properties: Brass.
   1. Metal, Heavy Duty: Thickness 0.062 inch (1.57 mm), minimum.
D. Edges: Beveled, on four sides unless otherwise indicated.
E. Fasteners: Countersunk screw fasteners.

2.12 KICK PLATES

A. Manufacturers:
   1. Ives, an Allegion brand: www.allegion.com/us/#sle.
   2. Trimco: www.trimcohardware.com/#sle.
   3. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch (203 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

2.13 FLOOR STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. Ives, an Allegion brand: www.allegion.com/us/#sle.
B. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Bumper, concave, wall stop.
   2. Material: Chrome housing with rubber insert.

2.14 THRESHOLDS

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. National Guard Products, Inc: www.ngpinc.com/#sle.
B. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.
   2. Type: Flat surface.
   3. Material: Clear anodized aluminum with thermal break.
   4. Threshold Surface: Fluted horizontal grooves across full width.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.15 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. National Guard Products, Inc: www.ngpinc.com/#sle.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with brush weatherstripping.
   4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
   5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.16 FIRE DEPARTMENT LOCK BOX

A. Manufacturers:
   1. Knox Company; Knox-Box Rapid Entry System: www.knoxbox.com/#sle.
      a. KnoxBox 3200 with hinged door.
      b. Confirm model to be provided with Clarendon Hills Fire Department.
   2. Substitutions: Not permitted.

B. Fire Department Lock Box:
   1. Heavy-duty, recessed mounted with RMK (recess mount kit), solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers.
   2. Capacity: Holds 2 keys.
   3. Finish: Manufacturer's standard silver.

2.17 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary FinishES:
      a. 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
      b. 628; satin aluminum, clear anodized.
      c. 630; satin stainless steel; for door levers and pulls.
      d. 652; satin chromium plated over steel.
   2. Exceptions:
      a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
      b. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordinate with door and frame manufacturers to provide necessary internally concealed reinforcing within doors and frames to allow for hardware installations and no through-bolting.

B. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Do not install surface mounted items until application of finishes to substrate are fully completed.

D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch (1024 mm).
      b. Push Plates/Pull Bars: 42 inch (1067 mm).
      c. Deadlocks (Deadbolts): 48 inch (1219 mm).
      d. Exit Devices: 40-5/16 inch (1024 mm).

E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.
B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.
B. Adjust hardware for smooth operation.
C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
B. Clean adjacent surfaces soiled by hardware installation.
C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work through Substantial Completion.
B. Do not permit adjacent work to damage hardware or finish.

3.07 HARDWARE SCHEDULE

A. General
   1. The Supplier shall examine the Door and Frame Schedule on the drawings in conjunction with the specifications herein and shall be responsible for furnishing all finish hardware for a complete and proper, turn-key installation.
   2. The hardware sets shall be reviewed by the Supplier to determine the extent of miscellaneous items incidental to the work which may be required to provide complete and proper operation of all specified hardware.

B. **HARDWARE SET** 1
   1. Application(s): Exterior, single door – Aluminum Glazed Egress Door.
      a. (1) Electronic Timed Lock / Lever – Satin Stainless Steel
      b. (1) Electric Power Supply – locate in mechanical room with concealed raceway (underslab) to curtain wall mullions and door subframe.
      b. (1 pair) Continuous Hinge with Electric Power Transfer – Clear Anodized Aluminum
      c. (1) Exit Device with Electric Latch Retraction – Brushed Stainless Steel.
      d. (1) Concealed Heavy Duty Door Closer with Stop Arm – Dull Aluminum.
      e. (1) Drop Plate.
      f. (1) Thermally Broken Threshold – Clear Anodized Aluminum.
      g. (1) Integral Concealed Door Sweeps – Clear Anodized Aluminum.
      h. (1) Outside Door Sweeps with Drip Cap – Clear Anodized Aluminum.
      i. (1 set) Weatherstrip Kit – Clear Silicone Bulb Seal.
      j. (1) Rim Cylinder – to match Lever Finish.
   2. Notes:
      a. Perimeter and meeting stile weatherstrip to be provided by Aluminum Door Supplier.
      b. Aluminum Door Supplier to contact Hardware Supplier for continuous (Roton) hinge model.

END OF SECTION

SECTION 088000
GLAZING

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Insulating glass units.
B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS
A. Section 084313 – Aluminum-Framed Storefronts: Glazing furnished as part of door assembly.
B. Section 084413 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.03 REFERENCE STANDARDS
A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
G. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
H. ICC (IBC) - International Building Code; 2015.
I. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
J. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
K. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS
A. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
C. Samples: Submit three samples 12 by 12 inch (305 by 305 mm) in size of glass units.
D. Samples: Submit 12 inch long bead of glazing sealant, color as selected.
E. Certificate: Certify that products of this section meet or exceed specified requirements.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

1.08 WARRANTY

A. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

2.02 INSULATING GLASS UNITS

A. Acceptable Manufacturers:
   1. Basis of Design: Guardian Glass, LLC: www.guardianglass.com/#sle.
   2. Oldcastle BuildingEnvelope: www.obe.com.
   3. Pilkington North America Inc: www.pilkington.com/na/#sle.
   4. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
   5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.

2.03 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Basis of Design - Insulating Glass Units: Vision glazing, with Low-E coating.
   1. Applications: Exterior insulating glass glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
   5. Overall Appearance: Clear.
   6. Total Thickness: 1 inch (25.4 mm).
   7. Thermal Transmittance (U-Value), Winter, Nighttime - Center of Glass: 0.29, nominal.
   8. Transmittance:
      a. Visible Light Transmittance (VLT): 62 percent, nominal.
      b. Ultraviolet Light Transmittance: 6 percent, nominal.
      c. Solar Energy Transmittance: 23 percent, nominal.
   9. Reflectance:
      a. Visible Light Out: 11 percent, nominal.
      b. Visible Light In: 12 percent, nominal.
      c. Solar Energy Out: 39 percent, nominal.
   10. Relative Heat Gain: 65.
   11. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
   12. Light to Solar Gain: 2.31.
   13. Glazing Method: Dry glazing method, gasket glazing.
   14. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   15. Metal Edge Spacers: Aluminum, bent and soldered corners.
   16. Spacer Color: Black.
   17. Edge Seal:

a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.

18. Color: Black.
19. Purge interpane space with dry air, hermetically sealed.
20. Outboard Lite: Fully tempered clear float glass, 5/16 inch (6.4 mm) thick, minimum.
    a. Low-E Coating: 62/27 on #2 surface.
21. Inboard Lite: Fully tempered clear float glass, 1/4 inch (6.4 mm) thick.
    a. Coating: No coating on inboard lite.

2.04 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
    1. Width: As required for application.
    2. Thickness: As required for application.
    3. Spacer Rod Diameter: As required for application.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
B. Verify that the minimum required face and edge clearances are being provided.
C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
D. Verify that sealing between joints of glass framing members has been completed effectively.
E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - PRESSURE GLAZED SYSTEMS

A. Application - Exterior Glazed: Set glazing infills from exterior side of building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install non-metallic pressure plates without displacing glazing gasket; exert pressure for full continuous contact.
E. Install cover plate.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
B. Remove non-permanent labels immediately after glazing installation is complete.
C. Clean glass and adjacent surfaces after sealants are fully cured.
D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

BUILDING OPENINGS – CONTINUED

Method of Measurement: Building Openings for payment on a lump sum basis. All work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for BUILDING OPENINGS.

FINISHES

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

SECTION 033511
CONCRETE FLOOR FINISHES

PART 1 GENERAL
1.01 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.
B. Polishing of concrete floor slabs with specific concrete aggregates.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing compounds that also function as sealers.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
B. (3) 12”x12” Samples using same mix as final slab installation.
C. Ground and Polished Concrete finish to match Architect’s samples.
D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 MOCK-UP

A. Construct mock-up slab area with same mix as final slab installation under conditions similar to those that will exist during application.
B. Ground and Polished Concrete finish to match Architect’s samples.
C. Mock-Up Size: 12’x16’.
D. Locate where directed.
E. Mock-up may not remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.07 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
B. Do not finish floors until interior heating system is operational.
C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Unless otherwise indicated, all concrete floors are to be finished using liquid densifier/hardener.
B. Liquid Densifier/Hardener:
    1. Use at following locations: all locations.
    2. At locations of polished concrete, apply prior to and during polishing process or as recommended by manufacturer.
C. Polished Finish:
    1. Provide up to a total of two (2) separate types of custom aggregates in order to provide polished floor finishes.
    2. Refer to Finish Plans for patterns of polished finish concrete.
    3. Provide liquid densifier/hardener during the polishing process, type compatible with the polishing process.
    4. Provide satin gloss clear sealer after the polishing process, type compatible with the polishing process.
    5. Provide code-required slip resistance.

2.02 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
B. Use / Location: For use on all natural concrete flooring, with our without applied coatings or coverings. Do not use for Polished Concrete Floor Systems.
    1. Composition: Lithium silicate.
    2. Products:

a. ARDEX Engineered Cements; "ARDEX PC-50": www.ardexamericas.com.
b. Concrete Earth; "Floor Shield": www.concreteearth.com
c. Dayton Superior Corporation; "Sure Hard™ Densifier J17": www.daytonsuperior.com.
d. Kaufman Products Inc.; "SureHard LS": www.kaufmanproducts.net.
e. L.M. Scofield Company; "SCOFIELD® Formula One™ Lithium Densifier MP": www.scofield.com.
f. Nox-Crete Products Group; "Duro-Nox LSC": www.nox-crete.com.
g. SpecChem, LLC; "LithSeal SC": www.specchemllc.com/sle.
h. W.R. Meadows, Inc; "Liqui-Hard Ultra": www.wrmeadows.com/sle.

2.03 POLISHED CONCRETE SYSTEM

A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen. Provide a complete system including all components required for polishing, coloring and finishing of the concrete surfaces.
   1. Acceptable Systems:
      a. ARDEX Engineered Cements; ARDEX PC-T Concrete Topping: www.ardexamericas.com.
      b. Concrete Earth; ECO GUARD Concrete Polishing System; ECOGUARD Pore Filler; ECOGUARD Pre-Grind; ECOGUARD Color Infusion; ECOGUARD MaxGloss; ECOGUARD Densifier & Hardener: www.concreteearth.com.
      c. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc; FGS Permashine Concrete Polishing System: www.lmcc.com/#sle.
      d. L.M. Scofield Company; SCOFIELD Formula One Ground & Polished Concrete Systems: www.scofield.com/#sle.
      e. PROSOCO, Inc; Consolideck Polished Concrete System: www.prosoco.com/consolideck/#sle.
      f. W. R. Meadows, Inc; Induroshine and Bellatrix Concrete Enhancer: www.wrmeadows.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.03 CONCRETE POLISHING

A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.
   1. Final Polished Sheen: Satin finish; other sheens are included as comparison to illustrate required sheen; final sheen is before addition of any sealer or coating, regardless of whether that is also specified or not.
   2. Satin Finish: Reflecting images from side lighting.
B. Protect finished surface as required and as recommended by manufacturer of polishing system.
C. Finish shall meet code-required slip resistance.

END OF SECTION

SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
    1. Reveals or joints where substrate panels are exposed to view.
    2. Mechanical and Electrical:
        a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
        b. In finished areas, paint shop-primed items.
        c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
D. Do Not Paint or Finish the Following Items:
    1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
    2. Items indicated to receive other finishes.
    3. Items indicated to remain unfinished.
    4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
    5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
    6. Floors, unless specifically indicated.
    7. Ceramic and other tiles.
    8. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
    9. Glass.
    10. Acoustical materials, unless specifically indicated.
    11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.
B. Section 099600 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
F. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.
G. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; 2015.
H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
I. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).
J. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).
K. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

B. Selection Samples: Submit one heavy paper "fack deck" illustrating complete range of colors available for each surface finishing product scheduled.

C. Verification Samples: Submit two paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.06 MOCK-UP

A. Provide panel, 4 feet (1.22 m) long by 4 feet (1.22 m) wide, illustrating paint color, texture, and finish.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
B. Paints:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   2. Benjamin Moore.
   3. PPG.
C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
B. Flammability: Comply with applicable code for surface burning characteristics.
C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
D. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   2. Allow for minimum of four colors for each system, unless otherwise indicated, without additional cost to Owner.
   3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, wood, uncoated steel, shop primed steel, and galvanized steel.
   1. 100% Acrylic, water reducible, corrosion resistant coating.
   2. At new and existing unfinished construction:
      a. Two top coats and one coat primer.
   3. At existing, finish painted construction:
      a. Two top coats.
   4. Top Coat(s):
      a. Sherwin Williams; Product Pro Industrial DTM Acrylic Coating.
      b. Benjamin Moore.
      c. PPG.
   5. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
      b. Eggshell: MPI gloss level 3; use this sheen at all locations.
   6. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
    1. Gypsum Wallboard: 12 percent.
    2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
    3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Concrete:
    1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
    2. Clean concrete according to ASTM D4258. Allow to dry.
H. Masonry:
    1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
    2. Prepare surface as recommended by top coat manufacturer.
I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
K. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
    2. Prepare surface according to SSPC-SP 2.
L. Ferrous Metal:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
    3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
F. Sand wood and metal surfaces lightly between coats to achieve required finish.
G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
B. Clean surfaces immediately of overspray, splatter, and excess material.
C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.05 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes until Substantial Completion.

END OF SECTION

SECTION 099600
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Work under this section consists of surface preparation, priming and finishing work necessary to complete the painting work indicated or reasonably implied on Drawings.
B. Use high performance coating systems specified in this section to coat surfaces as indicated.

1.2 REFERENCES

A. Publications listed herein are part of this specification to extent referenced.
B. Steel Structures Painting Council:
    1. SSPC SP-1 Specification for Solvent Cleaning
    2. SSPC SP-6 Commercial Blast Cleaning
    3. SSPC PA-1 Painting Application Specification
C. American Society for Testing and Materials (ASTM)
    1. ASTM D 4060 Standard Test Method for Abrasion Resistance.
    2. ASTM D 4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
    3. ASTM D 3363 Standard Test Method for Film Hardness by Pencil Test.
    4. ASTM D 2794 Standard Test Method for Measuring Direct Impact.
    5. ASTM B 117 Standard Test Method for Corrosion Resistance.
    6. ASTM D 4585 Standard Test Method for Measuring Humidity Resistance.
    7. ASTM G 53 (UVA-340 bulbs, 4 hours light , 4 hours dark) Standard Test Method for Measuring QUV Resistance

8. ASTM D 522 (Method A – Conical Mandrel) Standard Method for Measuring Flexibility
9. MIL-PRF-85285D Section 4.6.13 Standard Test Method for Cleanability.
10. ASTM D 4141, Method C (EMMAQUA) Standard Test Method for Exterior Exposure.
11. ASTM D 6578 Standard Test Method for Graffiti Resistance.
12. ASTM D 4587 Standard Test Method for QUV Exposure.
13. ASTM D 6695 Standard Test Method for Xenon ARC Weathering.

1.3 DEFINITIONS

A. Terms PAINT or PAINTING shall in a general sense have reference to aromatic urethane organic zinc rich primer, aliphatic acrylic polyurethane intermediate coat, and advanced thermoset solution fluoropolymer finish coat, and the application of these materials.
B. DRY FILM THICKNESS (DFT): Thickness, measured in mils, of a coat of paint in cured state
C. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's literature describing products to be provided, giving manufacturer's name, product name, product line number, and ASTM Test Method results for each material.
   2. Include technical data sheets for each coating, giving descriptive data, curing times, mixing, thinning, and application requirements.
      a. Provide material analysis, including vehicle type and percentage by weight and by volume of vehicle, resin and pigment.
      b. Submit manufacturer's Material Safety Data Sheets (MSDS) and other safety requirements.
B. Samples:
   1. Selection Samples: Submit color charts displaying manufacturer's full range of standard colors for initial selection by Engineer, Architect and Owner.
C. Quality Assurance Submittals:
   1. Certificates:
      a. Coatings manufacturer shall certify that coating materials utilized are "non-lead" (less than 0.06% lead by weight in dried film) as defined in Part 1303 of Consumer Product Safety Act.
      b. Provide certification that specialized equipment as may be required by manufacturer for proper application of coating materials shall be utilized for work of this Section.
      c. Provide manufacturer's certification that products to be used comply with specified requirements and are suitable for intended application.
D. Manufacturer's Instructions: Submit manufacturer's installation procedures, which shall be basis for accepting or rejecting actual installation procedures.
E. Warranty: Submit manufacturer’s standard 15 year check, crack, blister, delamination, corrosion, color, gloss, and chalking warranty.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacture of high performance coatings with a minimum of 10 years experience.
   2. Applicator: Company trained in application techniques and procedures of coating materials with a minumum of 10 years experience on similar projects.
B. Single Source Responsibility:
   1. Provide products of a single manufacturer or items standard with manufacturer of specified coating materials.
   2. Provide secondary materials which are produced or are specifically recommended by coating system manufacturer to ensure compatibility of system.

C. Regulatory Requirements: Conform to applicable codes and ordinances for flame, fuel, smoke, and volatile organic compound (VOC) ratings requirements for finishes at time of application.
D. Pre-Installation Meeting:
   1. Schedule a pre-installation meeting to be attended by Contractor, Owner's representative, coating applicators, and a representative of coating material manufacturer to be held on-site before field application of coating systems begins.
   2. Topics to be discussed at meeting shall include:
      a. Review of Contract Documents and accepted shop drawings with resolution of deviations or differences.
      b. Review items such as environmental conditions, surface conditions, surface preparation, application procedures, and protection following application.
      c. Establish on-site storage and working areas.
      d. Identify application requirements and required preparation work.
   3. Prepare a written report of pre-installation conference and submit to parties in attendance within 3 days following conference.

1.6 MOCK-UP

A. Before proceeding, prepare and provide a surface preparation and finish coating sample in a location as directed by the Architect/Owner. Sample shall determine surface preparation standards, application properties, and acceptable color and gloss appearances.
B. When approved, use finishes as standard for application, appearance and materials for similar areas or items throughout project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver products in manufacturer's original unopened containers, each having manufacturer's label, intact and legible.
   2. Include on label for each container:
      a. Manufacturer's name
      b. Type of paint
      c. Manufacturer's stock number
      d. Color name and number
      e. Instructions for thinning, where applicable
B. Storage and Protection:
   1. Store materials in a protected area, away from construction activities and restricted to paint materials and related equipment.
   2. Maintain temperature in area of storage between 40 degrees F (4 degrees C) and 110 degrees F (43 degrees C).
   3. Comply with health and fire safety regulations.
   4. Remove damaged materials from Site.

1.8 PROJECT CONDITIONS

A. Environmental Requirements for Application of Coating Materials:
   1. Air temperature: Not below 40 degrees F (2 degrees C) or above 110 degrees F (43 degrees C).
   2. Minimum Surface Temperature:
      a. Refer to specific product information sheets for minimum surface temperature requirements.
      b. Minimum 5 degrees F (15 degrees C) above dew point and in a rising mode.
      c. Relative humidity: no higher than 85%.
      d. Wind Velocity: For exterior spray application, less than 15 mph (25 kph).
      e. Atmosphere: Relatively free of airborne dust.

1.9 SEQUENCING

A. Perform work in proper sequence with work of other trades to avoid damage to finished work.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Tnemec Company, Inc. of Kansas City, Missouri. The paint products mentioned in the following specifications are set as standards of quality. Local Phone 708-387-0305. Local Fax 708-387-7941. Local Contact Chris Wascher.

PART 3 EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. Applicator trained in application techniques and procedures of coating materials with a minumum of 10 years experience on similar projects.

3.2 EXAMINATION

A. Examine areas and conditions under which application of coating systems is to performed for conditions that will adversely affect execution, permanence, or quality of coating system application.
B. Report conditions detrimental to timely and proper execution of Work to Architect.
C. Do not proceed until unsatisfactory conditions have been corrected.
D. Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance.

3.3 PROTECTION

A. Provide drop cloths, shields, and other protective equipment.
B. Protect elements surrounding work of this section from damage or disfiguration.
C. As Work proceeds, promptly remove spilled, splashed, or splattered materials from surfaces.
D. Post Wet Paint signs during application of coating materials and until surfaces are adequately cured.
E. Post No Smoking signs during application of solvent-based materials.
F. Take precautionary measures to prevent fire hazards and spontaneous combustion.
G. Remove empty containers from site.
H. Place cotton waste, cloths and hazardous materials in containers, and remove from site daily.
I. Protect work against damage until fully cured

3.4 SURFACE PREPARATION AND TOUCH-UP

A. General Requirements:
    1. Prior to application of primer, prepare surfaces to receive specified coating system in compliance with manufacturer's recommendations and specifications of Steel Structures Painting Council as specified in this Section.
    2. Clean surfaces completely free of grease, scale, rust, oil, dirt, and other foreign matter/contamination, immediately prior to priming.
    3. Provide dry and smooth surfaces, free from dust and foreign matter which will adversely affect adhesion or appearance.
B. Steel:
    1. Clean surfaces completely free of grease, rust, scale, dirt, dust, and oil.
    2. Surface Preparation:
        a. Prepare in accordance with SSPC SP-6 Commercial Blast Cleaning.

        b. All surfaces must be clean, dry, and free of contamination prior to the application of coatings.

3.5 REPAIR/RESTORATION

A. At completion of Work, touchup and restore finishes where damaged.
B. Defects in Finished Surfaces:

1. When stain, dirt, or undercoats show through final coat, correct defects and cover with additional coats until coating is of uniform finish, color, appearance and coverage.
2. Touchup minor damage: where result is not visibly different from surrounding surfaces.
3. Where result is visibly different, either in color, sheen, or texture, recoat entire surface.

3.6 FIELD QUALITY CONTROL

A. Testing Laboratory Services:
   1. Documents: Review Contract Documents and applicable sections of referenced standards.
   2. Field Painting Inspection:
      a. Verify cleaning operations to surfaces are to condition specified.
      b. Verify conformance of paint to specification.
      c. Check for thickness of each coating, final thickness and holidays.
      d. Check touchup for final finish.
   3. Reports:
      a. Submit written progress reports describing tests and inspections made and showing action taken to correct non-conforming work.
      b. Report uncorrected deviations from Contract Documents.

B. Manufacturer's Field Service: Coatings manufacturer to provide technical assistance and guidance for application of coating system.

3.7 CLEANING

A. At completion of day's work, remove from site rubbish and accumulated materials.
B. Clean paint spots and other soiling from pre-finished surfaces and surfaces with integral finish using solvents which will not damage finished surface.
C. Leave storage area clean and in same condition indicated for equivalent spaces in Project.

3.8 WASTE MANAGEMENT

A. General Requirements:
   1. Place materials defined as hazardous or toxic waste in designated containers.
   2. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal; pouring on ground not permitted.
   3. Place paints or solvents in designated containers for proper disposal.
   4. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

B. Containment/Disposal Requirements:
   1. Surface Preparation Debris Containment:
      a. When required by federal, state or local regulation, entire structure shall be enclosed and surface preparation debris contained.
   2. Disposal of Surface Preparation Debris:.
      a. Surface preparation debris shall be disposed of in compliance with applicable federal, state and local regulations.
   3. Containment/Disposal Costs: Contractor shall be responsible for costs associated with containment and waste disposal that may result from execution of this Project.

3.9 SCHEDULE OF COATING SYSTEMS

A. **Exterior Exposed Steel**:
   1. Surface Preparation: Prepare in accordance with SSPC SP-6 Commercial Blast Cleaning. All surfaces shall be clean and free of all dust, dirt, grease, oil and foreign matter prior to painting.
   2. Prime Coat: Apply one coat of Tnemec Series 90-97 Tnemec-Zinc at a dry film fhickness of 2.5 to 3.5 mils.

      After Prime Coat has cured, fill all voids, gouges, pits, bugholes and other surface anomalies with Tnemec Series 215 Surfacing Epoxy (WHERE DESIGNATED).

3. Intermediate Coat: Apply one Full Coat of Tnemec Series 73 Endura-Shield at a dry film thickness of 2.0 to 3.0 mils. Intermediate Coat Color to be determined by Tnemec Warranty Department.
4. Finish Coat: Tnemec Series 1072V Fluoronar (satin). Dry Film Thickness: 2.0 to 3.0 mils.
5. Total Dry Film Thickness: 6.5 to 9.5 mils.
6. Finish Coat Color to be determined by owner.
    a. White 00WH
    b. Intermediate coat to be grey or white in color.
    c. Finish texture to be smooth with no runs and minimal orange peel texture.

END OF SECTION

SECTION 104330
VINYL GRAPHIC SIGNAGE FILM

PART 1 GENERAL
1.01 SUMMARY
A. This Section includes the following:
    1. Reverse-read vinyl lettering applied to interior surface of exterior window glass as indicated on the Drawings.
        a. Daisy graphic on entrance all entrance doors at train station and shelters.
            1) As graphically indicated on elevation and signage Drawings.
        b. Building address at train station window glazing.
            1) Number and location to be determined.
B. Related Sections:
    1. Division 1 Section “Construction Waste Management” for disposal of construction waste and packaging.
    2. Division 8 Section “Glazing” for glass substrate.

1.02 SUBMITTALS
A. Product Data: Include material descriptions, product test reports, adhesion test reports, application requirements, storage and maintenance bulletins, post-installation cleaning and replacement procedures, and color chart.
B. Shop Drawings: Measured layout elevation drawing and full-size templates of each letter and graphic.
    1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
C. Samples for Selection: samples of manufacturer’s colors for selection of color(s).
D. Samples for Verification:
    1. Full-size sample of each printed graphic image.
    2. For building address: range of manufacturer’s standard frosted translucent white colors.
E. Signage Schedule
F. Certification: Submit installer’s certification from manufacturer.
G. Warranty: Submit for review.

1.03 QUALITY ASSURANCE
A. Installer Qualifications: An authorized representative of manufacturer for installation and maintenance of graphic film required for this Project.
B. Source Limitations: Obtain graphic film through one source from a single manufacturer.
C. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for installation.
D. Pre-installation Conference: Conduct pre-installation conference at site.

1.04 PROJECT CONDITIONS

A. Field Measurements: Field measurements must be made prior to installation of graphics and final layout submitted as shop drawing for review and approval prior to pre-installation conference.

1.05 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

1.06 EXTERIOR and INTERIOR VINYL GRAPHIC FILM

A. Vinyl Graphic Film:
   1. Color: As selected by Architect from full range of manufacturer's colors.
   2. Printing or Imaging: As indicated on the Drawings.
   3. Graphic images to be provided by Architect.
   4. Compatibility: Confirm compatibility of vinyl graphics material with scheduled substrates.
   5. Product: Subject to compliance with requirements, provide Controltac Plus, Graphic Film 181-10 by 3M or approved equal.

B. Fabricator and Installer:
   1. Source One Digital; web: www.sourceonedigital.com
   2. ASI-Modulex, 2650-C West Bradley Place, Chicago, IL 60618, 773.871.0102
      a. Contact: Dan Salamone
   3. Poblacki Sign Company, 922 South 70TH Street, Milwaukee, WI, 53214, 414.453.4010.

PART 3 - EXECUTION

1.07 EXAMINATION

A. Cleaning Requirements: Surfaces should be free of all dirt, construction debris, etc.

1.08 INSTALLATION

A. Comply with manufacturer's written instructions for all installation procedures including but not limited to cutting, seaming, etc.
B. Temperature, Precipitation, and Atmospheric Condition: Per manufacturer's written instructions.
C. Do not install damaged components.
D. All joints/seams to be hairline and consistently located. There should be no loose edges or seems that may gather dirt or that may cause delamination.

1.09 ERECTION TOLERANCES

A. Lettering
   1. Plumb: 1/16" within each letter; no variance greater than 1/8" between any two letters.
   2. Level: 1/16" within the letter; 1/8" overall length of installation.

B. Graphic Images
   1. Plumb: 1/8" overall image.
   2. Level: 1/8" overall length of installation.

1.10 REPAIR AND REPLACEMENT

A. Repair or replace damaged graphics.

END OF SECTION

SECTION 124816
ENTRANCE FLOOR GRILLES

PART 1 GENERAL

1. DESCRIPTION OF WORK
   1. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
      1. Heavy duty rigid Floor Grilles for entrance with commercial traffic.
      2. Substrate preparation.
      3. Recessed Frames
   2. Related Work: The following items are not included in this Section and are specified under the designated Sections:
      1. Section 03 30 00 Cast-In-Place Concrete.
   3. References (Industry Standards):
      1. ASTM International (ASTM):
         1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus
         2. ASTM E1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
         3. ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
         4. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
2. SUBMITTALS
   1. Product data: Submit product data, including manufacturer's specification sheet and installation instructions for specified products and each accessory proposed for use. Include methods of installation and substrate preparation for each type of substrate.
   2. Shop drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Include notation that grilles are to align from unit to unit.
   3. Samples: Submit samples for each type and color of exposed entrance grid, premium poly-brush and carpet selections, frames and accessories required. Provide samples of grid materials.
   4. Quality Assurance Submittals: (1) Certified test reports showing compliance with specified performance characteristics and physical properties, and (2) Manufacturer’s Installation Instructions.
   5. Closeout Submittals: (1) Cleaning & Maintenance Data (Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance), and (2) Warranty.
3. QUALITY ASSURANCE
   1. Manufacturer Qualifications: Manufacturer must be capable of providing technical field service representation.
   2. Installer Qualifications: Installer should be highly experienced in performing work of this section, having previously done work similar to that required for this project
4. DELIVERY, STORAGE, AND HANDLING
   1. Comply with Manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.
   2. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.
   3. Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.
   4. Store materials at temperature and in humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.
5. PROJECT CONDITIONS
   1. Maintain ambient and concrete temperature and humidity levels as described within the installation instructions.

2. Verify actual measurements by field measuring before fabrication and include measurements in shop drawings. To avoid construction delays, coordinate field measurements and fabrication schedule based upon construction progress.

6. WARRANTY
   1. Provide manufacturer's standard limited warranty.

PART 2 PRODUCTS

1. ACCEPTABLE MANUFACTURER FOR ENTRANCE FLOOR GRILLES
   1. Grate Grid by Mats Inc., 179 Campanelli Parkway Stoughton MA 02072; Telephone 800-MATS-INC (800628-7462); Fax 781-344-1537; www.matsinc.com.
      a. Limited Warranty: Two years from date of substantial completion.
      b. Material: Aluminum Alloy type 6063-T52 spaced 1-1/2" on center and secured with key-lock bars on 6" centers. Both centers and key-lock bars are to be welded in place for maximum strength.
      c. Inserts: Carpet or poly-brush.
      d. Blades: T-Shaped blades, 1-1/4 'T' shaped blades with spacing between blades not to exceed 1/8 inch.
      e. Color: Selected from manufacturer's standard colors as offered for premium poly-brush and carpet.
      f. Frame Recess: 1-3/4".
      g. Trim: Profile as indicated on Drawings, stainless steel or dull aluminum, isolate dissimilar materials.
      h. Rolling Load Limit: 350 lbs per wheel.
   2. Base Grid GB-700 by Base Specialties, 525 First Street, Farmington, MN 55024; Telephone 1-866-391-6216; www.base-spec.com.
   3. Pedigrid G1 by CS Entrance Flooring, www.c-sgroup.com.

PART 3 EXECUTION

1. SUBSTRATE PREPARATION
   1. Examine substrates and conditions where floor mats will be installed. Do not proceed with installation until unsatisfactory conditions are corrected. Sub floor shall be clean and dry, and within acceptable tolerances.
   2. Supply a safe, climate controlled building and subfloor that meets the requirements of *ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring* is required, or as detailed in the Mats Inc. Advanced Track installation instructions. This includes a structurally sound concrete subfloor, new concrete slabs must conform to *ASTM C33/C33M — Standard Specification for Concrete Aggregate*.
2. INSTALLATION
   1. Sizes: Shop-fabricate units of aluminum grids to greatest extent possible in sizes as indicated. Where not indicated otherwise, provide single unit for each grid installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where joints in grids are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints. Where possible, verify sizes by field measurement before shop fabrication.
      a. Floor grilles (mats) to align from unit to unit.
   2. Accessories: Where indicated for recessed or wall-to-wall installations, provide aluminum framework as recommended by manufacturer.
   3. General: Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent tripping hazards.
      a. Chemical adhesive removers must not be used.
      b. A secure storage and installation area that is maintained permanently or temporarily at the required ambient service temperature and humidity, so the flooring contractor can acclimate the flooring materials, is required for at least 24-hours prior to and during the application of the flooring.

3. CLEANING AND PROTECTION
   1. General Cleaning: Refer to Manufacturer's Cleaning and Maintenance Instructions.
   2. Protection: Protect installed product and finish surfaces from damage during construction and until acceptance.
      1. Areas with direct prolonged exposure to sunlight must be protected with the use of Low E glass doors and windows, facades or a protective film over the glass.
      2. Prevent debris from entrapment underneath the floor grilles.
   3. Owner's Personnel: Instruct Owner's personnel in proper maintenance procedures.

END OF SECTION

FINISHES – CONTINUED

Method of Measurement: Finishes for payment on a lump sum basis. All work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for FINISHES.

BUILDING SIGNAGE

Description: This work shall consist of constructing the outbound Metra shelter building at the location shown on the plans.

Metra's signage standards document is included at the end of the Special Provisions document; it is not available as a DOC file so it is not inserted into this location.

BUILDING SIGNAGE – CONTINUED

Method of Measurement: Building Signage for payment on a lump sum basis. All work associated with the shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for BUILDING SIGNAGE.

PLUMBING EQUIPMENT, ACCESSORIES AND RELATED SYSTEMS

Description: This work shall consist of constructing all plumbing-related work associated with the outbound Metra shelter building at the location shown on the plans.

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - **GENERAL**

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

B. Related Sections include the following:
   1. Division 22 Section "Sanitary Sewerage Pumps."
   2. Division 22 Section “Sanitary Piping Specialties.”

3.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. NBR: Acrylonitrile-butadiene rubber.
D. TPE: Thermoplastic elastomer.

4.02 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.
   2. Sanitary Sewer, Force-Main Piping: 50 psig.

6.01 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
   1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
   1. Sovent Drainage System: Include plans, elevations, sections, and details.
B. Field quality-control inspection and test reports.

9.02 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 11 – PRODUCTS

11.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

13.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

14.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

16.01 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

A. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. 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.

B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

PART 19 - EXECUTION

19.01 EXCAVATION

C. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

19.02 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

A. Aboveground, vent piping NPS 3 and smaller shall be the following:

1. Copper tube, copper drainage fittings, and soldered joints.
   a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

A. Aboveground, vent piping NPS 4 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

A. Underground, soil and waste piping NPS 4 shall be the following:

1. Service class, cast-iron soil piping; gasketed caulking materials joints.

26.01 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

A. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

A. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

A. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

C. 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.

D. 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 2 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.

E. 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.

F. 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; 1 percent downward in direction of flow for piping NPS 4 and larger.
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.

B. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

C. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

D. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

33.02 JOINT CONSTRUCTION

E. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

F. 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.

G. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

H. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

33.03 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

34.02 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. 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.

B. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

36.02 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. Reinspection: 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.

37.02 CLEANING

E. Clean interior of piping. Remove dirt and debris as work progresses.
F. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
G. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 2 - GENERAL

2.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.02 SUMMARY

B. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Roof flashing assemblies.
   4. Through-penetration firestop assemblies.
   5. Miscellaneous sanitary drainage piping specialties.
   6. Flashing materials.

B. Related Sections include the following:
   1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
   2. Division 22 Section "Plumbing Fixtures" for hair interceptors.

4.02 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.

5.02 SUBMITTALS

H. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
1. FOG disposal systems.
2. Grease interceptors.
3. Grease removal devices.
4. Oil interceptors.

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
1. Wiring Diagrams: Power, signal, and control wiring.

8.01 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.

8.02 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate size and location of roof penetrations.

9.02 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 12 - RODUCTS

15.01 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. Watts Drainage Products Inc.
c. Zurn Plumbing Products Group.
1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: as required to match connected piping.
4. Closure: Countersunk plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
1. Closure: Stainless-steel plug with seal.

A. Metal Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Watts Drainage Products Inc.
b. Mifab
c. Zurn Plumbing Products Group.
1. Standard: ASME A112.36.2M for heavy duty, adjustable housing cleanout.
2. Size: Same as connected branch.

22.01 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. Watts Drainage Products Inc.
c. Zurn Plumbing Products Group.

2. Standard: ASME A112.6.3.

25.01 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.
c. MIFAB, Inc.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

28.02 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Manufacturers: Subject to compliance with requirements, manufactures offering products that may be incorporated into the work include the following criteria:
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. 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.

29.02 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **2 inches** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

A. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

A. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

35.01 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.
G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 39 - EXECUTION

39.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
C. 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.
D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
F. 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.
B. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
C. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
A. Install fixture air-admittance valves on fixture drain piping.
B. Install stack air-admittance valves at top of stack vent and vent stack piping.
C. Install air-admittance-valve wall boxes recessed in wall.
A. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
B. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
C. Install deep-seal traps on floor drains and other waste outlets, if indicated.
D. 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.
E. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
A. Install vent caps on each vent pipe passing through roof.

A. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
B. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
A. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
B. Install wood-blocking reinforcement for wall-mounting-type specialties.
C. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
D. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

46.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.
C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

47.02 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.
B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.
A. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
B. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
A. Fabricate and install flashing and pans, sumps, and other drainage shapes.

50.02 FIELD QUALITY CONTROL

A. 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.

51.02 PROTECTION

B. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
C. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221413
FACILITY STORM DRAINAGE PIPING

PART 2 - GENERAL

2.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.02 SUMMARY

B. This Section includes the following storm drainage piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

3.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.
B. LLDPE: Linear, low-density polyethylene plastic.
C. PE: Polyethylene plastic.
D. PVC: Polyvinyl chloride plastic.
E. TPE: Thermoplastic elastomer.

4.02 PERFORMANCE REQUIREMENTS

F. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

A. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures." Insert applicable code requirement.

6.02 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
   1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
   1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

B. Field quality-control inspection and test reports.

9.02 QUALITY ASSURANCE

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 11 - PRODUCTS

11.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

13.02 PIPING MATERIALS

B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

14.01 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

PART 16 - EXECUTION

16.01 EXCAVATION

D. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

16.02 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

A. Aboveground storm drainage piping NPS 6 shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

A. Underground storm drainage piping NPS 6 and smaller shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed calking materials; and calked joints.

A. Underground, storm drainage piping NPS 8 and larger shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed calking materials; and calked joints.

24.02 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

A. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

C. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

A. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

C. 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.

D. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.

E. Lay buried building storm 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.

F. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

B. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

C. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

31.02 JOINT CONSTRUCTION

D. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

E. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

F. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

G. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

31.03 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      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. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

A. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3: 60 inches with 1/2-inch rod.
   2. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   3. NPS 6: 60 inches with 3/4-inch rod.
   4. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

B. Install supports for vertical cast-iron soil piping every 15 feet.

33.02 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:
   1. Storm Sewer: To exterior force main or storm manhole.
   2. Sump Pumps: To sump pump discharge.

35.02 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.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: 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 storm drainage 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage 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. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. 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.

36.02 CLEANING

F. Clean interior of piping. Remove dirt and debris as work progresses.
G. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
H. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

PLUMBING EQUIPMENT, ACCESSORIES AND RELATED SYSTEMS – CONTINUED

Method of Measurement: Plumbing Equipment, Accessories and Related Systems will be measured for payment on a lump sum basis. All plumbing-related work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for PLUMBING EQUIPMENT, ACCESSORIES AND RELATED SYSTEMS.

MISCELLANEOUS ELECTRICAL WORK

Description: This work shall consist of constructing all electrical-related work associated with the outbound Metra shelter building at the location shown on the plans.

SECTION 260503
GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings
B. Project Information, Instructions to Bidders, and Execution Documents
C. Standard Terms and Conditions for Construction Contracts
D. Standard Terms and Conditions Procedures Manual

1.02 SUMMARY

A. Section includes general administrative, material, and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01.
   1. Electrical product general requirements and accesses.
   2. Substitutions.
   3. Submittals.
   4. Alternates.
   5. Coordination drawings.
   6. Record documents.
   7. Maintenance manuals.
   8. Rough-ins.
   9. Electrical installations.
   10. Cutting and patching.

1.03 DEFINITIONS

A. Definitions:
   1. Listed: Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintain periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for use in a specified manner.
   2. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by who's labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
   3. General Explanation: A substantial amount of specification language consists of definitions of terms found in other Contract Documents, including Drawings. (Drawings are recognized as being diagrammatic in nature and not completely descriptive of the requirements indicated thereon). Certain terms used in Contract Documents are defined in this article. Definitions and explanations contained in this Section are not necessarily either complete or exclusive but are general for the Work to the extent that they are not stated more explicitly in another element of the Contract Documents.
   4. General Requirements: The provisions or requirements of other Division 01 Sections apply to entire work of the Contract and where so indicated, to other elements which are included in the project.
   5. Indicated: The term "indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping the reader locate cross- references, and no limitation of location is intended except as specifically noted.
   6. Directed, Requested, etc: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "reviewed", "required", "accepted", and "permitted" mean "directed by the METRA Field Representative", and similar phrases. However, no such implied meaning will be interpreted to extend the responsibility the METRA Field Representative into the Contractor's area of construction supervision.
   7. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations, as applicable in each instance.
   8. Install: Except as otherwise defined in greater detail, the term "install" is used to describe operations at the job site, including unloading, unpacking, assembly, erection, placing, anchoring, mounting, connecting, testing, protecting and cleaning, placing in working condition and similar operations, as applicable in each instance.

9. Provide: Except as otherwise defined in greater detail, the term "provide" means to furnish and install, complete and ready for intended use, as applicable in each instance.
10. Installer: The term "installer" is defined as the entity (person or firm) engaged by the contractor, its subcontractor or sub-subcontractor for performance of a particular unit of work at the project site. It is a general requirement that such entities (installers) be expert in the operation they are engaged to perform.
11. Connect: The term "connect" means to provide power sources, overcurrent devices, raceway, conductors, terminations, insulation and other materials required for the operation and control of the equipment noted by the term.
12. Wiring: The term wiring means all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.
13. Conduit: The term conduit means the inclusion of all fittings, hangers, supports, sleeves, etc.
14. Concealed: The term concealed means embedded in masonry or other construction, installed behind wall furring or within partitions, or installed within suspended ceilings.
15. Exposed: The term exposed means not installed underground or concealed as defined above.
16. Accessible: The term accessible means being capable of being reached without the use of ladders or without climbing or crawling under, through or over obstacles such as other mechanical or electrical equipment, building members or structure, piping, ductwork or going through doors.

1.04 SUBMITTALS

A. General: Follow the procedures specified in Division 01 Section “Submittal Procedures.” If submittals include any deviations from specified equipment/materials, these deviations must be clearly identified. The reason for the deviation must also be indicated.

B. Prepare shop drawings and obtain approvals from inspection authorities for power utility company, fire alarm and life systems, and other electrical installations requiring specific approval.

C. Submit coordination drawings for areas specified and those areas defined as “problem” coordination areas during construction.

D. Submit ¼” scaled coordination drawings in electronic PDF format of electrical equipment room layouts prior to issuing electrical switchboard and equipment submittals to engineer of record. Layout shall be based on equipment being submitted for approval. In addition to electrical equipment room layouts, contractor shall also include all major conduit raceway systems 2” conduit trade size and larger for both underground and overhead including all pull and junction boxes. The contractor’s electrical coordination drawings shall be fully coordinated with all trade contractor’s equipment and shall bear each trade contractor’s approval stamp and signature on each coordination plan drawing submittal.

E. Electronic drawing files in AutoCad 2013 of the electrical drawings for use in preparing submittals may be purchased from the engineer. These drawings will not be provided without charge to the contractor or any of the subcontractors.

F. Documents will not be accepted for review unless:
1. They comply as to number of copies and type of paper indicated in the General Requirements.
2. They include complete information pertaining to appurtenances and accessories.
3. They are submitted as a package where they pertain to related items.
4. Where they consist of standard catalog sheets displaying other items which are not applicable, they are properly marked with the electrical data, product identification and accessories as related to this specific project.
5. They indicate the project and address along with the Contractor's name, address and phone number.
6. Where they consist of standard factory assembly or field installation drawings, they are properly marked with external connection identification as related to this specific project.

G. Any materials, fixtures, apparatus, or equipment that are not in accordance with specification requirements can and will be rejected for use in this installation and construction.
H. Any materials, fixtures, apparatus or equipment installed without stamped or written review will be removed by the Contractor and replaced with specified equipment at the direction of the Architect/Engineer and without recourse for additional compensation.
I. Prepare and submit all shop drawings to governmental agencies and utility companies which are required by these agencies for their approval.
J. Contractor's and General contractor's review and stamped prior to submitting for review by the Field Representative.

1.05 QUALITY ASSURANCE

A. Carefully examine the contract documents, visit the site, and become thoroughly familiar with the local conditions relating to the work. Failure to do so will not relieve the contractor of the obligations of the Contract.
B. Discovery of any conflicting design information or any design intentions which are not readily interpreted shall be referred to the Field Representative for further description or illustration prior to any product selection or execution of work.
C. Discovery of any materials or equipment which are damaged, unsuitable, incompatible, or non-compliant with any applicable codes, laws, ordinances or other regulations shall be brought to the direct attention of the Field Representative.
D. Should there be any discrepancies or question of intent, refer the matter to the Field Representative for a final decision before ordering any equipment or materials and before starting any relating work.
    1. In case of conflict between project specifications and drawings, the Contractor shall assume the more expensive method for purposes of bidding, unless the Architect/Engineer rules otherwise.
E. Manufacturers of equipment shall be firms regularly engaged in manufacturing factory fabricated systems and equipment whose products have been in satisfactory use in similar service for not less than 5 years.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery product to the project properly identified with names, model numbers, types grades, compliance labels, and other information needed for identification.

1.07 RULES AND REGULATIONS

A. Work and materials shall conform to and be execute, inspected and tested in accordance with the latest edition of the National Electrical Code and the governing rules and regulations of Federal, State and Local governmental agencies.
B. Other codes which will apply to this installation include the current editions of:
    1. ANSI C2 – National Electrical Safety Code.
    2. ASME/ANSI A17.1 - Safety Code for Elevators and Escalators.
    3. ASTM - American Society for Testing and Materials.
    4. ICEA - Standards for Wire and Cable.
    5. IEEE Standards.
    6. IESNA Standards.
    7. NEMA Standards.
    8. NFPA 20 - Standards.
    9. OSHA Regulations.
    10. Underwriters Laboratories.
C. Where governing codes indicate the Drawings and Specifications do not comply with the minimum requirements of applicable codes, the Contractor shall either notify the Architect/Engineer in writing during the bidding period identifying the revisions required to meet code requirements or provide an installation which will comply with the code requirements.

D. Where regulations of electric utility and telephone companies apply, conformance with their regulations is mandatory and any costs involved shall be included in the Contract, with the exception of extra facility and other charges which are directly paid by the Owner.
E. Where any materials, equipment or installation is not in compliance with the more stringent of the applicable codes, laws, ordinances, regulations and contract documents, they shall be entirely removed, replaced, modified or otherwise corrected at no additional cost.

1.08 SUBSTITUTIONS

A. The materials, products and equipment described in the Bidding Documents establish a standard of required functions, dimensions, appearance and quality to be met by any proposed substitutions.
B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten (10) days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance, test data and warranties, and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other work than incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
C. If the Architect approved any proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. This Addendum shall then be issued to all Bidders.
D. Requests for substitution shall be made only by a Bidder. Request for substitution received by Engineer from Sales representative, vendors, suppliers etc., are not acceptable.
E. Refer to Division 01 Section "Substitution Procedures" for additional instructions on substitution.

1.09 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Openings: Wall, floor, ceiling, and roof openings specifically shown and identified on the Architectural and Structural or Electrical Drawing shall be provided.
B. Roof Sleeves: Electrical Contractor shall provide all roof penetrations and sleeves for all conduits serving HVAC equipment and shall be incorporated into the finished roofing and made watertight according to the roof construction type manufacturer's recommendations.
C. Painting: Painting of all exposed-to-view conduit, pipes, unfinished hangers, supports, and equipment, insulated or not, in finished and unfinished areas, shall be provided. Furnish all manufactured equipment in factory-finished baked enamel, unless otherwise specified.

1.10 WIRING AND CONTROLS

A. Wiring and controls associated with equipment shall be furnished, installed, and wired in accordance with the manufacturer's recommendations and applicable standards and codes. Provide installation instructions, locating dimensions, and wiring diagrams for the other trades. Supervise the installation and start-up and test the equipment unless otherwise specified.
B. Equipment Furnished by Other Divisions: Equipment specified in other Divisions and requiring electrical supply shall be erected, aligned, leveled, and prepared for operation. Provided required controls and accessories along with installation instructions, diagrams, dimensions and supervision of installation and start-up. Provide the required electrical rough-ins, and confirm the electrical controls and accessories furnished under the specifications for the other Divisions. Install those controls and accessories not located in the mechanical piping and ductwork. Provide additional electrical controls, accessories, fittings, and devices not specified under the equipment but required for a finished, operating job. Make final electrical connections. Participate in the start-up and test services.

1.11 PERMIT AND INSPECTIONS

A. Permits: Obtain and pay for all permits, bonds, licenses, tap-in fees, etc., required by the City, State, or other authority having jurisdiction over the work, as a part of the work of the affected Section.

B. Inspections: Arrange and pay for all inspections required by the above when they become due as part of the work of the Sections affected. Conceal no work until approved by these governing authorities. Present the Field Representative with properly signed certificate of final inspection.

1.12 REVIEW OF MATERIALS

A. Within 21 calendar days after award of this Contract, submit a typewritten list of all items of equipment and material proposed for installation on this Project to the Field Representative for review for design conformance. Set forth the specification page number, manufacturer's name, model number, size, nonstandard accessories specified or required, and any other information required to identify each item.

1.13 PROJECT SITE CONDITIONS

A. Inspect and examine the site before submitting the proposal. Note the location of any existing facilities, existing services or interference with other trades. Immediately contact the Field Representative indicating discrepancies. Failure to do so will not relieve the Contractor of the obligations of the Contract.

B. Visit the site or premises in order to become familiar with job conditions. No extras will be allowed for work which could have been foreseen by an examination of the site or premises.

C. Adjust work to meet actual conditions existing at the job.

D. Inspect and examine the site to determine how equipment will be transported to final mounting locations. No extra charges will be allowed for moving, hoisting or otherwise transporting equipment to final mounting location.

E. The location and routing of power and communication utility service raceway systems shown on the site plan and associated plan drawings are diagrammatic only. The contractor shall coordinate with all new and existing overhead and underground utilities (power utility service company, communication utility service company, etc.). Contractor shall verify and confirm with power and communication service utility providers the exact location and routing of proposed underground and overhead conduits prior to rough-in. Contractor shall obtain an official sign-off from such utility service providers prior to performing any work. Failure to do so shall not relieve the contractor from providing what is required by the utility service providers and shall not result in an added cost to the contract.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected.

B. The equipment to be provided under these Specifications shall be essentially the standard commercial grade product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.

C. The listing of a manufacturer for certain equipment and systems does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems shall conform to the Specifications.

2.02 U.L. LISTING & LABELING

A. All equipment shall bear the Underwriter's Laboratories (U.L.), or other approved agency, listing label.

B. Wherein an item of equipment is specified to be U.L. Listed, the entire assembly shall be listed by Underwriters laboratories, Inc. Any modifications to suit the intent of the Specifications, shall be performed in accordance with the National Electrical Code.

PART 3 - EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 02 through 14, 22, 23, and 26 for rough-in requirements.

C.

3.02 ELECTRIAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. The Owner's Field Representative shall control the placement of wall and ceiling mounted electrical devices, fixtures, and outlets. The intent is to aesthetically locate fixtures/outlets by providing rough-in hardware, boxes and/or mounting plates, as required, when stud or furring may not be readily available for direct mounting. When drawing details are not available, consult with the Owner's Field Representative for actual placement.
2. Coordinate electrical systems, equipment, and materials installation with other building components. Be responsible for any changes in openings and locations necessitated by the equipment installed.
3. Verify all dimensions by field measurements.
4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
5. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-concrete and other structural components, as they are constructed.
6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Owner's Field Representative.
9. Switchgear/Switchboard/Motor Control Center Assembly Selection: The drawings indicate sizes, profiles, and dimensional requirements of assembly equipment. Equipment having equal performance characteristics and complying with indicated maximum dimensions and profiles may be considered, provided deviations do not change the design concept, intended performance, or code/future extension provision clearances. The burden of proof of equality is on the proposer a minimum of 10 days prior to bid.
10. Protect all equipment and materials from the elements, dirt and other damage from the time it is removed from the point of storage until final acceptance.
11. Equipment shall include the component parts thereof such as disconnect switches, motor starters, motors, drives, and guards necessary to the satisfactory and safe operation of the equipment.
12. Installation shall include setting equipment to accurate line and grade, leveling equipment, aligning equipment components, providing and installing couplings, bolts, guards and anchor bolts.
13. All tolerances in alignment and leveling, and the quality of workmanship for each class and stage of work shall be subject to manufacturer's installation instructions.
14. All manufacturers' finished equipment surfaces damaged during construction shall be brought to an "as new" condition by touch up or repairing. Any rust shall be completely removed and the surface primed prior to repainting.
15. Workmanship shall conform to the "Standard of Installation" published by the National Electrical Contractors Association.
16. Prior to start of utility trench work, notify the Architect of utilities that require excavations lower than the building foundations. Do not proceed with trench work without direction

from the Architect to ensure the building foundations will not be compromised by the utility installation.

17. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from the premises when no longer required.
18. No electrical equipment, raceways or other work of any kind shall be covered up or hidden from view before it has been examined and approved. Any unsatisfactory work or materials shall be removed and corrected immediately.
19. Install systems, materials, and equipment level and plumbing, parallel and perpendicular to other building systems and components.
20. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
21. Install access panels or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 26 Section "Basic Electrical Materials and Methods."
22. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.03 MANUFACTURER'S DIRECTIONS AND SUPERVISION

A. Where supervision by a manufacturer is specified, follow all instructions, recommended manufacturer and specified field tests, and other recommendations of the manufacturer. The manufacturer shall supervise the installation, connection, start-up, testing, and adjustment, instruction of the Owner's Field Representative and final tests of such equipment or system. Where two or more manufacturer's equipment are interrelated, take responsibility to coordinate their work and provide supervision.

B. Have the manufacturer instruct the Owner's Field Representative in the proper operation and maintenance techniques of all equipment, systems, etc., at the time of completion of all work.

C. Prior to final acceptance by the Owner's Field Representative prepare and submit to the Architect for review 3 copies of operation and maintenance (O and M) instructions in printed form for each item of equipment or system installed in the building. Complete instructions for each system shall be assembled and bound in a brochure. Detailed contents of the O and M manuals are as hereinafter specified. Refer to appropriate Division 01 Sections for general requirements affecting this work.

3.04 PAINTING

A. Provide the prime painting of all equipment and materials furnished under Division 26 specifications, unless specifically stated otherwise. In general, all equipment except raceways and galvanized boxes that are not provided with a factory-applied final finish shall be delivered to the job site with a shop-applied prime coat of paint.

3.05 TEST AND INSPECTION

A. Upon completion of the work, notify the Architect in writing, that the entire electrical installation has been examined, inspected, tested, calibrated or adjusted as specified and that it is ready for final inspection. Work to be connected prior to final inspection and also to include all of the work specified for "Manufacturers' Directions and Supervision." Include documentation of specified testing and inspection.

B. Prior to each inspection, provide a written certification that each system or piece of equipment to be operated during that test has been tested and does meet design performance criteria of the Contract Documents.

C. On completion of work, obtain Certificates of Compliance, and approval or acceptance from all authorities having jurisdiction over the work, and deliver these certificates to the Owner's Field Representative The work shall not be deemed to have reached a state of completion until the certificates have been delivered.

3.06 LOOSE EQUIPMENT

A. Provide four keys for every different piece of electrical equipment which is equipped with a lock.
B. Provide all other loose equipment specified/supplied for use with all systems.

3.07 SHOP DRAWINGS

A. Refer to Division 01 for quantities and types of shop drawings.
B. Required shop drawings shall be submitted in groups by systems. For example, all lighting fixtures, lamps, ballasts and accessories shall be submitted simultaneously in one package.
C. Refer to individual Division 26 Sections for required shop drawings.
D. Shop drawings submitted for other than those specifically required in the appropriate Specification Section will not be reviewed or returned.

3.08 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01 Section "Operating and Maintenance Data". In addition to the requirements specified in Division 01, include specific Division 26 Section requirements, and the following information for equipment items:
   1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   4. Servicing instructions and lubrication charts and schedules.
B. The minimum information that shall be furnished in the maintenance manual shall include the following:
   1. Individual Characteristics for trouble shooting sequences for each item of:
      a. Branch circuit panel.
      b. Distribution panel.
      c. Fire alarm system.
      d. Individual motor starter.
      e. Switchboard.
      f. Transformer.
      g. UPS.
      h. Surge Protection Devices.
      i. Battery Inverter System.
      j. Lighting Inverter.
      k. Lighting control components and panels
      l. Catalog cut sheets for every item for which a shop drawing is required.
      m. Schedule of loads served for each:
         1) Branch circuit panel.
         2) Distribution panel.
         3) Switchboard.
      n. On-hand spare parts list and complete parts list for each:
         1) Distribution panel.
         2) Individual motor starter/VFD.
         3) Switchboard.
      o. Overload element schedule for each motor starter.
      p. Bolt tightening torques and inspection intervals on each:
         1) Bolted bus connection.
         2) Cable connection.
         3) Miscellaneous bolted electrical connections
   2. Catalog cut sheets for every item for which a shop drawing is required.
   3. Schedule of loads served for each:

a. Branch circuit panel.
b. Distribution panel.
c. Switchboard.

4. On-hand spare parts list and complete parts list for each:
   a. Distribution panel.
   b. Individual motor starter.
   c. Switchboard.
5. Tap setting schedule for each:
   a. Transformer.
6. Overload element schedule for each motor starter whether individual or in a motor control center.
7. Bolt tightening torques and inspection intervals on each:
   a. Bolted bus connection.
   b. Cable connection.
   c. Miscellaneous bolted electrical connections.
8. Manufacturers' recommended cleaning intervals and special procedures for each:
   a. Cooling fins.
   b. Dry-type transformer coil assembly.
   c. Electrical equipment interior.
   d. Electrical equipment ventilation opening.
   e. Lighting fixture lenses, louvers and reflectors.
9. Main and arcing contact adjustment and replacement for each:
   a. Contactor.
   b. Circuit breaker.
   c. Fused switch.
   d. Interrupter switch.
   e. Motor starter.
10. Calibration and exercise procedures and intervals for each:
    a. Control system.
    b. Emergency battery.
    c. Molded case breaker.
    d. Relay.
11. "As designed" and "as left" relay settings.
12. Testing interval and target values for ground fault protection circuit relays.
13. Testing and trouble shooting procedures unique to special systems.
14. Approved special construction details that differ from the details shown on Drawings.

3.09 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of ¼" = 1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited to installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
   b. Exterior wall and foundation penetrations.
   c. Fire-rated wall and floor penetrations.
   d. Equipment connections and support details.
   e. Sizes and location of required concrete pads and bases.
2. Coordination drawings shall be provided by Division 26 for the following:
   a. Access door locations.

b. Communication rooms.
c. Electrical equipment rooms.
d. Mechanical equipment rooms.
e. Power factor correction capacitor locations.

3. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
4. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

3.10 RECORD "AS-BUILT" DOCUMENTS

A. The Contractor shall be responsible for creating and providing accurate "As Built" drawings from field data collected during the course of the project. Field data is defined as information collected on site while constructing the project that is not available from the contract documents, addenda, change orders, or site instructions. It is of importance that the Contractor record on the "As Builts" all field information relating to concealed conditions.

B. The revisions from contractor markups and field inspection notes shall be transferred to the final as-built set of drawings. The final as-built drawings include modifications during construction, field requested changes, bulletins, shop drawing modifications, and contractor designs.

C. At the completion of construction all of the contractor's red-lined changes shall be transferred to electronic CAD drawings, typically using the engineer of record's original design drawing files as the starting point. These CAD drawings shall then be considered the final "as-builts" and shall be submitted to the engineer and owner in both electronic CAD format and PDF format as part of the project close out process. Hand marked-up as built drawings shall not be acceptable.

D. Prepare record "As-Built" documents/drawings in accordance with the requirements in Division 01 Section "Project Closeout." In addition to the requirements specified in Division 01, indicate installed conditions for:

1. Plan drawings indicating major raceway systems (100 amps and greater), conduit and wire sizes, routing and location, for both exterior and interior, locations of equipment, switchboards, panelboards, control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Major equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Accurate electrical diagrams (electrical riser diagrams, wiring diagrams, etc.) reflective of all modifications during construction, field requested changes, bulletins, shop drawing modifications, and contractor designs.
4. Accurate record of all switchboard and panelboard branch circuit directories/schedules which reflect actual installed circuits.
5. Accurate branch circuit numbers and associated panelboard designations of all power receptacle outlet devices, electrical equipment, lighting fixtures and associated controls, etc.
6. Contract Modifications and actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the State of Illinois as specified in Section "FIELD ENGINEERING" to record the locations and invert elevations of underground installations.

END OF SECTION

SECTION 260505
BASIC ELECTRICAL MATERIALS AND METHODS

PART 4 - GENERAL

4.01 SUMMARY

A. Section includes the limited scope construction materials and methods for application with electrical installations as follows:

1. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
2. Miscellaneous materials for support of electrical materials and equipment.
3. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment requiring maintenance and/or operation.
4. Concrete equipment bases.
5. Cutting and patching for electrical construction.
6. Touchup painting.
7. Mounting heights.
8. Electrical equipment coordination and installation.
9. Sleeves for raceways and cables.
10. Sleeve seals.
11. Common electrical installation requirements.

4.02 DEFINITIONS

A. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification
2. Subbase: As used in this Section refers to the compacted soil layer used in pavement systems between subgrade and the pavement base course material.
3. Subgrade: As used in this Section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Owner's Field Representative.

4.03 SUBMITTALS

A. Shop drawings are not required for material and equipment specified under this Section of the specifications.

4.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in National Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with National Electrical Code and local code ammendments.
C. Installer Qualifications: Engage an experienced installer for the installation and application of joint sealers, access panels, and doors.
D. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code – Steel."
1. Certify that welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

4.05 PROJECT CONDITIONS

A. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
3. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of

conditions. The Owner's Field Representative will not be responsible for interpretations or conclusions drawn from this information.

4. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
5. Remove existing underground utilities indicated to be removed.
   a. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
   b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Architect prior to utility interruption.
6. Use of explosives is not permitted.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

4.06 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
   1. Coordinate installation and connection to exterior underground and overhead utilities and services, including provision for electricity-metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

PART 5 - PRODUCTS

5.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Access Doors:
   2. Bar Co., Inc.
   3. J.L. Industries
   4. Karp Associates, Inc.
   5. Milcor Dir. Inryco, Inc.
   6. Nystrom, Inc.

B. Provide all low voltage data, communication, security, audio and video equipment as required by the Owner's field representative. Provide all required shop drawings and proceed with installation after shop drawings are approved.

5.02 MISCELLANEOUS MATERIALS

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
C. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
D. Expansion Anchors: Carbon-steel wedge or sleeve type.
E. Toggle Bolts: All-steel springhead type.
F. Powder-Driven Threaded Studs: Heat-treated steel.

5.03 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete withattachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
   1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
   2. For gypsum wallboard or plaster: Perforated flanges with wallboard bead.
   3. For full-bed plaster applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14-gage sheet steel, concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-allied prime paint.
   1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism, 1-1/2 hr. “B” labeled.

D. Locking Devices: Flush, screwdriver-operated cam locks.

5.04 CONCRETE BASES

A. Concrete Forms and Reinforcement Materials: As specified in Division 03 Section "Cast-in-Place Concrete."

B. Concrete: 3000 psi, 28 day compressive strength as specified in Division 03 Section "Cast-in-Place Concrete."

5.05 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

5.06 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated “wall pipe,” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052 inch or 0.138 inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

5.07 SLEEVE

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of conduit. Include type and number required for material and size of raceway.
   2. Pressure Plates: Carbon steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 6 - EXECUTION

6.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

6.02 EXCAVATION

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

C. Install sediment and erosion control measures in accordance with local codes and ordinances.

D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

E. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

F. Excavation for Underground Vaults and Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within dri-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
   2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is place.

G. Trenching: Excavate trenches for electrical installations as follows:
   1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.
   2. Excavate trenches to depth indicated or required.
   3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
   4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
   5. Saw-cut existing concrete slabs, pavements, etc. due to new underground electrical conduit or conduit duct bank installation and patch to match existing construction and finish.

H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F.

I. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in PART 2 of this Section.
   1. Under walls and pavements, use a combination of subbase materials and excavated or borrowed materials.
   2. Under building slabs, use drainage fill materials.
   3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.

4. For raceways less than 30 inches below surface of roadways, provide 4 inch thick concrete base slab support. After installation of raceways, provide a 4 inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas, use excavated or borrowed materials.

J. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

K. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

L. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

M. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

N. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Percentage of Maximum Density Requirements: Company soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

O. Subsidence: Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, qualify, and condition of surface of finish to match adjacent areas.

6.03 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

6.04 INSTALLATION OF ACCESS DOORS

A. Submit coordination drawings indicating proposed access door locations for review per Section 26.
B. Install access doors, sized to permit complete access for any concealed and/or inaccessible junction boxes, control and monitoring devices, duct mounted fire alarm detectors and other items of equipment requiring access maintenance, and/or operation.
C. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
D. Adjust hardware and panels after installation for proper operation.

6.05 FIRESTOPPING

A. Additional firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

6.06 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000 psi, 28 day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

6.07 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”
C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
E. Rectangular sleeve Minimum Metal Thickness:
    1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
    2. For sleeve cross-section rectangle perimeter equal to or greater than 50 inches, and 1 or more sides equal to or greater than 16 inches, thickness shall be 0.138 inch.
F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
G. Cut sleeves to length for mounting flush with both surfaces of walls.
H. Extend sleeves installed in floors 2 inches above finished floor level.
I. Seal space outside of sleeves with grout for penetrations of concrete and masonry with approved joint compound for gypsum board assemblies.
J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section “Joint Sealants” for materials and installation.
K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway penetration sleeves with firestop materials. Comply with Division 07 Section “Penetration Firestopping.”
L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible boot-type flashing units applied in coordination with roofing work.
M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

6.08 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section “Cutting and Patching.” In addition to the requirements specified in Division 01, the following requirements apply:
   1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
      a. Uncover Work to provide for installation of ill-timed Work.
      b. Remove and replace defective Work.
      c. Remove and replace Work not conforming to requirements of the Contract Documents.
      d. Remove samples of installed Work as specified for testing.
      e. Upon written instructions for the Architect, uncover and restore Work to
      f. provide for Architect observation of concealed work.
   2. Cut, remove, and legally dispose of electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
   3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
   4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and direct to adjacent areas.
   5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
   6. Patch finished surfaces and building components using new materials matching materials and experienced Installers. Installers’ qualifications refer to the materials and methods required for the surface and building components being patched.

6.09 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Excavation for underground utilities.
   2. Concrete bases.
   3. Cutting and patching for electrical construction.
   4. Touchup painting.

B. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

6.10 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 09 Section "Painting."
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

6.11 MOUNTING HEIGHTS

A. Mounting heights of electrical items shall be as listed below, unless otherwise specified, or by the Architect/Engineer’s field instructions. Dimensions are above finished floor, unless otherwise indicated. In areas where code requires different mount heights, as in hazardous areas, comply with code requirements.

1.	General Receptacles	-18” to C.L.
2.	Outdoor Receptacles	-24” to C.L.
3.	General Tele and Data Outlets	-18” to C.L.
4.	General Toggle Switches	-48” to C.L.
5.	General Television Outlets	-18” to C.L.
6.	Fire Alarm Audio Visual Devices	-80” to C.L.
7.	Exit Signs	-90” to C.L.
8.	Individual Disconnects and Starters	-60” to C.L.
9.	Panelboard Overcurrent Devices	>12” to C.L.

6.12 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 260511
CONDUCTORS AND CABLES FOR ELECTRICAL SYSTEMS

PART 7 - GENERAL

7.01 SUMMARY

A. Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for cables.

7.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

7.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

7.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in National Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with National Electrical Code.

7.05 DELIVERY, STORAGE AND HANDLING

A. Deliver wire and cables according to NEMA WC26.

7.06 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

B. Coordinate layout and installation of cables with other contractors.

PART 8 - PRODUCTS

8.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Conductors and Cables
   a. American Insulated Wire Corp.; a Leviton Company.
   b. General Cable Corporation.
   c. Senator Wire & Cable Company.
   d. Southwire Company.
2. Connectors and Splices
   a. AFC Cable Systems, Inc.
   b. Hubbell Power Systems, Inc.
   c. O-Z/Gedney; EGS Electrical Group LLC.
   d. 3M; Electrical Products Division.
   e. Tyco Electronics Corp.

8.02 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.
B. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, and XHHW.

8.03 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 9 - EXECUTION

9.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger. Conductors shall be increased if voltage drop exceeds 3% and conductor length is greater than 100 linear feet. Conduit size shall be increased as required to conform with electrical code.
B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger. Conductors shall be increased if voltage drop exceeds 3% and conductor length is greater than 100 linear feet. Conduit size shall be increased as required to conform with electrical code.

9.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW, XHHW-2 or USE, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.
F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
H. Class 1 Control Circuits: Type THHN-THWN, in raceway.
I. Class 2 Control Circuits: Type THHN-THWN in raceway.
J. Fire Alarm Circuits: Red conductors, type THHN-THWN in raceway.

9.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. 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.
C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
E. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
F. Install wires and cables according to manufacturer's written instructions and NECA's "Standard of Care".
G. Remove existing abandoned wires from raceway before pulling in new conductors.

9.04 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 and UL 486B.
B. Make splices 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.
D. Keep conductor splices to a minimum.
E. Connect conductors to outlets and components as indicated and as instructed by manufacturers.
F. Splices and taps for up to #10AWG may be with wire nuts. For larger cable, mechanical or compression type connectors must be used.
G. Splices and taps for #8AWG and larger cables must be insulated using cold shrink or heat shrink tubing listed for such use.
H. All splices and taps must be made in a junction box or pull box. They may not be made in raceway, in panelboard or switchboard wiring space, or pulled into conduit.
I. All termination to bus bar must be made with listed lugs suitable for use with copper cable. Lugs for #2AWG and larger cable must be 2-hole lugs. All lugs must be compression type. Set screw type is not acceptable.
J. All splices, taps, and lug installation must utilize oxide inhibiting compound where suggested by the device manufacturer.

9.05 CONTRACTOR STARTUP AND REPORTING

A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
C. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 10 - GENERAL

10.01 SUMMARY

A. Section includes methods and materials for grounding systems and equipment for electrical.

B. Furnish and install complete grounding and bonding system as shown or as implied in the Contract Documents:
   1. Equipment grounding.
   2. Wiring device grounding.
   3. Panelboard grounding.
   4. Grounding/Earthing System
   5. Basic Grounding/Earthing and Bonding
C. Furnish and install a complete equipotential ground system for data processing systems in strict conformance with National Electrical Code, Section 250.

10.02 DEFINITIONS

A. Equipment Grounding Conductor: (EGC):
   1. The conductor that connects the non-current-carrying metal parts of equipment to the grounding electrode conductor or ground bus.
B. Grounding Electrode Conductor: (GEC)
   1. The conductor that connects the grounding electrodes to the grounded circuit conductor and/or the equipment grounding conductor.
C. Grounded Circuit Conductor: (GCC)
   1. A circuit conductor, usually the neutral that is intentionally connected to ground.
D. Made Electrode: (ME)
   1. Any item, such as a ground rod, which is used to provide a ground connection.

10.03 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.
   3. Grounding for sensitive electronic equipment.
C. Field quality-control test reports. Indicate overall resistance to ground.
D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
   1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

10.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the National Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
C. Comply with UL 467 for grounding and bonding materials and equipment.
D. Comply with National Electrical Code.
E. Comply with ANSI-T-STD-607-A for grounding and bonding of Telecommunication Systems.
F. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground. The contractor must also be approved by the Owner.
G. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

10.05 REFERENCES

A. IEEE 1100 - Recommend Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book).
B. TIA/EIA-606 – Administration Standard for the Telecommunications Infrastructure.
C. TIA J-STD-607 – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications; Rev A. 2002.
D. TIA-942 – Telecommunications Infrastructure Standard for Data Centers.

PART 11 - PRODUCTS

11.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Electrodes:
      a. Burndy.
      b. Harger.
      c. NSI Industries.
      d. Thomas and Betts.
   2. Mechanical Connectors: Bronze
      a. Burndy.
      b. Harger.
      c. NSI Industries.
      d. Thomas and Betts.
   3. Exothermic Connections:
      a. Burndy.
      b. Cadweld.
      c. Ultraweld (Harger).

11.02 CONDUCTORS

A. Equipment Grounding Conductors: Insulated with green color insulation.
B. Grounding-Electrode Conductors: Stranded cable.
C. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.
D. Insulated Conductors: wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
E. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
F. Bonding Straps: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.
G. Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green (equipment ground) or green/yellow tracer (isolated ground) in color, and all jackets shall be UL, VW-1 flame rated.

11.03 CONNECTORS

A. All connectors shall be two-hole long barrel (double indent) bolted-type hydraulic copper compression connectors and shall be used for conductors larger than #8 AWG. All compression connectors for cable sizes #1/0 AWG and larger shall employ hex or circumferential type crimps, and shall have an inspection hole between the tongue and barrel. The cable shall be completely inserted into the connector before the crimps are made. All solid wire ground connections must be exothermically welded or, if run in the interior, soldered.

Provide flame retardant insulating covers. All compression and mechanical connections shall be coated with the corrosion preventative compound.

B. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Heavy duty Pipe Clamps: Pipe clamps shall be high copper alloy or cast bronze with silicon bronze threaded fasteners; saddle type designed for the size of conductor indicated or required by Contract Documents.
   2. Beam Clamps: Beam clamps shall be compression type; heavy duty bronze construction; provide a minimum of 8 square inches of bonding surface; and designed for copper rope-lay cable.
   3. Grounding Bushings: Groundings bushings shall be malleable iron, threaded, with insulated liner and solderless lug.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

E. All buried connections shall be exothermic welds. All exposed mechanical and/or high compression connections shall be treated with a protective, anti-oxidant coating. All exothermic welds to galvanizing surfaces shall be sprayed with galvanizing paint.

F. Pressure Connectors: High –conductivity plated units.

G. Terminating Lugs:
   1. Exothermic weld or crimp compression type.

11.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: ¾ inch by 10 feet.

11.05 GROUNDING SYSTEM CONDUIT

1. All grounding system conduit raceways shall be factory painted “GREEN” unless otherwise noted.

PART 12 - EXECUTION

12.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor.
   1. Bury at least 24 inches below grade.

C. Grounding Bus: Provide a ground bus in Main Electrical room and Telephone/Server/MDF and IDF equipment rooms, housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 1 inch minimum, from wall 6 inches above finished floor, unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

D. 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.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

12.02 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. 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.

C. Water Heater and Heat-Tracing: 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.

D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

12.03 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. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   1. Verify existing conditions prior to beginning work.
   2. Verify that final backfill and compaction has been completed before driving rod electrodes.
   3. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   4. 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.

D. 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 so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

12.04 CLEANING

A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed,

replace it as soon as possible after backfilling has been completed. Restore areas disturbed by trenching of dirt, cable laying, and other activities to their original condition. Include trenching, storing of dirt, cable laying, and other areas to their original condition. Include topsoiling, fertilizing, liming, sodding, sprigging, and mulching. Comply with Division 32 Section “Plantings.” Maintain restored surfaces. Restore disturbed paving as indicated.

12.05 CONTRACTOR STARTUP AND REPORTING

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance not less 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.

B. Report measured ground resistances that exceed the following values:
   2. Power and Lighting Equipment or System with Capacity 500 kVA and less: 10ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
   5. Substations and Pad-Mounted Equipment: 5 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 13 - GENERAL

13.01 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

13.02 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

13.03 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Manufacturer’s Qualifications: Company specializing in manufacturing Products specified in this Section with minimum three years experience.
C. Listing and Labeling: Provide products specified in this Section that are listed and labeled:
   1. Listing and labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” as defined in OSHA Regulation 1910.7.
D. Comply with National Electrical Code.

13.04 DELIVERY, STORAGE AND HANDLING

A. Material delivered to jobsite shall be stored in original packaging per manufacturer's requirements.

13.05 COORDINATION

A. Provide steel supports, anchor bolts, inserts, etc., for all equipment specified under this section of the specifications.
B. Floor-mounted electrical equipment shall be installed on a minimum of 4 inch concrete housekeeping pads with a minimum of 4 inch equipment inset on all sides. Concrete shall be in accordance with referenced concrete specification section.
C. Provide formed steel support channels extending from and solidly anchored to the floor and ceiling slabs and mount the designated equipment thereto.
D. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

13.06 PROVIDE CONCRETE PADS FOR:

A. Power Utility Company Transformers as per utility company standards.
B. Transformers.

13.07 PROVIDE STEEL SUPPORT CHANNELS FOR:

A. Communication and special systems cabinets.
B. Disconnect switches.
C. Fire alarm system cabinets.
D. Individual motor starters and controllers.
E. Individual circuit breakers.
F. Distribution and Panelboards.
G. Wall mounted and trapeze mounted transformers.

13.08 WARRANTY - NOT APPLICABLE

PART 14 - PRODUCTS

14.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
    1. Steel Slotted Support Systems:
        a. Allied Tube & Conduit.
        b. Cooper B-Line, Inc.; a division of Cooper Industries.
        c. GS Metals Corp.
        d. Thomas & Betts Corporation.
        e. Unistrut; Tyco International, Ltd.
    2. Powder Actuated Fasteners
        a. Hilti Inc.
        b. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        c. MKT Fastening, LLC.
        d. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
    3. Mechanical-expansion Anchors
        a. Cooper B-Line, Inc.; a division of Cooper Industries.
        b. Empire Tool and Manufacturing Co., Inc.
        c. Hilti Inc.
        d. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        e. MKT Fastening, LLC.
    4. Conduit Sealing Bushings:
        a. Bridgeport Fittings, Inc.
        b. Cooper Industries, Inc.
        c. Killark Electric Mfg. Co.

d. O-Z/Gedney
e. Raco, Inc.
f. Spring City Electrical Mfg. Co.

14.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Products for outdoor use shall be hot-dip galvanized after fabrication and applied according to MFMA-4.
2. Other supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

14.03 MANUFACTURERD SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps as described in NECA 1 and NECA 101.
B. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
C. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs shall have number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
D. U-Channel Systems: 12-gauge steel channels, with 9/16 inch diameter holes, at a minimum of 2 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.
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-heat-treated 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.
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.
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.

14.04 VIBRATION ISOLATORS

A. General: Provide vibration isolators with either known un-deflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
1. Provide isolators that operate in the linear portion of their load versus deflection curve. Furnish load versus deflection curves from the manufacturer that are linear, over a deflection range 50% above the design deflection.
B. Vibration Isolator Types

1. General Properties:
   a. The ratio of lateral to vertical stiffness shall be not less than 0.9 or greater than 1.5.
   b. The theoretical vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than (+/-) 10%.
   c. Wave motion through the isolator shall be reduced to the following extent: Isolation above the primary vertical system resonance frequency shall follow the theoretically predicted isolation curve for single degree of freedom systems with 1-dB to 50 dB at all frequencies above the 150 Hz.
   d. All neoprene mountings shall have a shore hardness of 40 –65 after minimum aging of 30 days, or corresponding open-aging.
2. Isolator Description:
   a. Type MS shall be spring type, without housings or snubbers, equipped with leveling bolts and with two layers of ribbed or waffled neoprene pads, separated by a 1/16" galvanized steel plate under the base plate. Neoprene sleeves and washer shall be installed at all anchor bolts.
   b. Type HS shall be suspension hangers having a steel frame and spring element, in series with a neoprene pad, cut or washer. The isolator shall be designed so that hanger rod may be misaligned 15 degrees in any direction relative to the vertical, without contacting hanger box frame.
   c. Type MN shall be neoprene isolator support type unit having a minimum static deflection of ¼".
   d. Type HN shall be a suspension hanger type employing a neoprene isolator unit having a minimum static deflection of ¼".

C. Equipment Frames
1. Mounting frames and brackets shall be provided to carry the load of the equipment without causing mechanical distortion or stress to the equipment.
2. The mounting frames shall consist of welded, wide flange or channel structural steel, with welder brackets to accept the isolators. The section depth of any frame member shall be not less than 1/10th of the length of the longest frame member, and not less than 1/10th of the greatest span between support points. All frame members shall have the same depth.

14.05 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.
C. Pipe Sleeves: Provide pipe sleeves of one of the following:
1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
   a. 3 inch and smaller: 2 gauge.
   b. 4 inch to 6 inch: 16 gauge.
   c. Over 6 inch: 14 gauge.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 15 - EXECUTION

15.01 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 scheduled in Table 1 at the end of this Section. 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 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.
E. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
F. Dry Locations: Steel materials.

15.02 SUPPORT INSTALLATION

A. Comply with NECA 1, NECA 101 and manufacturer's instructions for installation requirements except as specified in this Article.
B. Raceway Support Methods: In addition to methods described in NECA 1, RMC EMT, IMC, and RMC may be supported by openings through structure members, as permitted in the National Electrical Code.
C. 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.
D. 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: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Spring-tension clamps.
   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.
   9. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   10. Fasteners: Select so the load applied to each fastener does not of its proof test load.
   11. Holes cut to depth of more than 1-1/2" in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
   12. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration and shock-resistant fasteners for attachments to concrete slabs.
E. Vibration Isolators:
   1. All floor supported transformers in excess of 300 kVA located within the building shall be mounted on isolation units utilizing type MS springs, appropriately secured to the transformer housing. Spring units shall be selected for a minimum static deflection of 1.5 inch.

2. All floor supported transformers equal to or less than 300 kVA located within the building shall be mounted on vibration isolation rails utilizing type MN neoprene mounts selected to deflect a minimum of 0.25 inch.
3. Suspended transformers 45 kVA and less shall be supported on an appropriate steel frame from Type HS hangers, selected for a minimum static deflection of 0.75 inch.

15.03 INSTALLATION

A. Where equipment supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.
B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the support of equipment, conduit, etc. Welding shall be permitted only when approved by Architect.
C. Coordinate dimensions of concrete housekeeping pads with requirements for equipment supplied.
D. Install supporting devices to fasten electric components securely and permanently in accordance with CEC requirements.
E. Coordinate with the building structural system and with other electrical installation.
F. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
G. Raceway Supports: Comply with the CEC and the following requirements:
   1. Conform to manufacturer's recommendations for selection and installation of supports.
   2. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
   3. Support parallel runs of horizontal raceways together on trapeze-type hangers.
   4. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼ inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
   5. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with CEC.
H. Vertical Conductors Supports: Install simultaneously with installation of conductors.
I. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.
J. Do not use ceiling system components for support.
K. Provide weight-distributing facilities, where required, so as not to exceed the load-bearing capabilities of floors or walls that bear the weight of, or support, electrical systems.
L. Exposed part of hangers and supports shall be painted with one coat of rust-inhibiting primer.
M. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.
N. Miscellaneous Supports: Support miscellaneous electrical components as required to provide the same structural safety factors as specified for raceway supports. Install metal channel or angle iron racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
O. In overhead spaces, boxes shall be supported independently of raceways. Support boxes directly from the building structure or by bar hangers. Where bar hangers are used for boxes, attach the bar to raceways on opposite side of the box and support the raceway with an approved type of fasteners not more than 2 inches from the box.
P. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls fro raceways can cable installations. For sleeves through fire-rated wall or floor construction, see Division 8 Section "Firestopping" for appropriate UL listed firestopping system.
Q. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

R. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Instead of expansion bolts, threaded studs or nails driven by a power charge may be used in existing concrete.
   6. Steel: Welded threaded studs or spring-tension clamps on steel.
      a. Field Welding: Comply with AWS D1.1.
   7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   8. Light Steel: Sheet-metal screws.
   9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load or the manufacturer's published allowable load capacity. For electrical cable or premises wire hangers for communications. Select nail, screw, or anchor suitable for base material. Space hangers according to cable bundle weight and sagging requirements.
   10. Holes cut to depth of more than 1-1/2" in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
   11. Use vibration and shock-resistant anchors for vibratory equipment or support attachments to concrete slabs.

S. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

T. Vibration Isolators:
   1. All floor supported transformers in excess of 300 kVA located within the building shall be mounted on isolation units utilizing type MS springs, appropriately secured to the transformer housing. Spring units shall be selected for a minimum static deflection of 1.5 inch.
   2. All floor supported transformers equal to or less than 300 kVA located within the building shall be mounted on vibration isolation rails utilizing type MN neoprene mounts selected to deflect a minimum of 0.25 inch.
   3. Suspended transformers 45 kVA and less shall be supported on an appropriate steel frame from Type HS hangers, selected for a minimum static deflection of 0.75 inch.

15.04 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

B. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

C. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

D. Field Welding: Comply with AWS D1.1/D1.1M.

15.05 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-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "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.

15.06 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 2.0 mils.
B. Touchup: Comply with requirements in Division 09 Section "Painting" for cleaning 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.

15.07 CLEANING

2. The Contractor shall at all times, keep the site free from accumulations of waste material or rubbish caused by its employees or work. Remove all crates, cartons, and other waste materials or trash from the working areas at the end of each working day. Flammable waste material must be removed from the working areas at the time of generation. Al rubbish and debris, combustible or not, shall be discarded in covered metal containers daily and removed from the premises at least weekly and legally disposed of.
3. The Contractor shall be responsible for the general cleaning and maintenance of the premises and for the coordination and direction of the cleanup work of all trades. Each trade shall clean and maintain its portion of the work as required and as directed by the General Contractor.
4. Clean all electronic equipment per manufacturer’s requirements as it relates to the project.
5. Clean interior and exterior of concentrator enclosures.
6. All equipment shall be cleaned prior to final acceptance.

15.08 SCHEDULES

TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conductors in Run		Maximum Spacing of Supports (Feet)	
			RGS & IMC*	EMT
Horizontal Runs				
½, ¾	1 or 2	Flat ceiling or wall.	5	5
½, ¾	1 or 2	Where it’s difficult to provide support except at intervals fixed by the building construction.	7	7
½, ¾	3 or more	Any location.	7	7
½ - 1	3 or more	Any location.	7	7
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or 2	Where it is difficult to provide support except as intervals fixed by the building construction.	10	10

TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conductors in Run		Maximum Spacing of Supports (Feet)	
1 & larger	3 or more	Any location.	10	10
Any	--	Concealed.	10	10
Vertical Runs				
½, ¾	--	Exposed	7	7
1, 1 ¼	--	Exposed	8	8
1 ½ and larger	--	Exposed	10	10
Up to 2	--	Shaftway	14	10
2 ½	--	Shaftway	16	10
3 & larger	--	Shaftway	20	10
Any	--	Concealed	10	10

* Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

Abbreviations:		
	EMT	Electrical metallic tubing.
	IMC	Intermediate metallic conduit.
	RGS	Rigid galvanized steel conduit.

END OF SECTION

SECTION 260533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 16 - GENERAL

16.01 SUMMARY

A. Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

16.02 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. FMC: Flexible metal conduit.
D. IMC: Intermediate metal conduit.
E. LFMC: Liquid-tight flexible metal conduit.
F. RNC: Rigid nonmetallic conduit.

16.03 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

16.04 QUALITY ASSURANCE

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
   1. The Terms “Listed and Labeled”: As defined in National Electrical Code.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
B. Comply with NECA's "Standard of Installation."
C. Comply with National Electrical Code.

16.05 DELIVERY, STORAGE AND HANDLING – NOT APPLICABLE

A. Effectively protect all materials, accessories, and components form any damage or injury from the time of fabrication until final acceptance by the METRA's Field Representative.

B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.

C. Store equipment in spaces with environments controlled within manufacturer's ambient temperature and humidity tolerances for non-operating equipment.

16.06 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 17 - PRODUCTS

17.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Metal Conduit and Tubing
   a. Allied Tube & Conduit; a Tyco International Ltd. Co.
   b. Maverick Tube Corporation.
   c. O-Z Gedney; a unit of General Signal.
   d. Wheatland Tube Company.
2. Nonmetallic Conduit
   a. CertainTeed Corp.; Pipe & Plastics Group.
   b. Electri-Flex Co.
   c. RACO; a Hubbell Company.
3. Metal Wireways
   a. Cooper B-Line, Inc.
   b. Hoffman.
   c. Square D; Schneider Electric
4. Surface Metal Raceways:
   a. Wiremold Company (The); Electrical Sales Division
   b. Hubbell Incorporated
   c. Raco
5. Boxes, Enclosures, and Cabinets
   a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   b. EGS/Appleton Electric.
   c. Hoffman.
   d. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
   e. O-Z/Gedney; a unit of General Signal.
   f. RACO; a Hubbell Company.
   g. Walker Systems, Inc.; Wiremold Company (The).
   h. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

17.02 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. IMC: ANSI C80.6.

C. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquid-tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   2. Fittings for EMT: compression type with insulated throat.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

17.03 NONMETALLIC CONDUIT

A. RNC: NEMA TC 2, unless otherwise indicated.
B. LFNC: UL 1660.
C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
D. Fittings for LFNC: UL 514B.

17.04 METAL WIREWAYS

A. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
B. Fittings and Accessories: Include 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.
C. Wireway Covers: Screw-cover type.
D. Finish: Manufacturer's standard enamel finish.

17.05 SURFACE RACEWAYS

A. Acceptable manufacturers:
   1. Wiremold.
   2. Anixer.
   3. Raco.

B. Two-Piece Combination Surface Metal Raceways
   1. Wiremold G-4000 series, two-piece with compartment divider for power devices and communication cable openings.
   2. Galvanized steel, color (coordinate with Architect).
   3. Dimensions: 1-3/4 in. deep x 4-3/4 in. wide.
   4. Surface mounted.
   5. Complete with:
      a. Wall box connectors
      b. Internal elbows.
      c. Combination duplex receptacle and communication outlet covers.
      d. Divider clip and coupling.
      e. All necessary appurtenances.
      f. 1/2 in. grommets for communication cable.
      g. 20-amp, 120-volt, 3-wire duplex receptacles (see specification paragraph "WIRING DEVICES").
      h. All wiring.
   6. Two Piece Surface Metal Raceways:
      a. Wiremold G-3000 series, two-piece with base and cover.
      b. Galvanized steel, color (coordinate with Architect).
      c. Dimensions: 1-17/32 in. deep x 2-3/4 in. wide.
      d. Surface mounted.
      e. Complete with”
         1) Wall box connectors.
         2) Internal elbows.

3) Duplex receptacle covers as required.
4) All necessary appurtenances.
5) 20-amp, 120 volt, 3-wire duplex receptacles (see specification paragraph "WIRING DEVICES").
6) All wiring.

C. Surface Metal Raceways and associated backboxes and coverplates: Galvanized steel with snap-on covers. Manufacturer's standard enamel color coded finish for each system type as follows:
1. Lighting and power receptacle circuits – Natural metallic enamel finish.
2. Grounding system – Green.
3. Fire alarm system – Red.
4. Low voltage (voice, data, signal, temperature control) system – Blue
5. Isolated ground system – Orange.
6. Video surveillance Security and access control systems – Yellow

17.06 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
D. Metal Floor Boxes: Cast metal, fully adjustable rectangular.
E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
H. Cabinets:
1. NEMA 250, Type 1, 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 18 - EXECUTION

18.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: IMC.
2. Concealed Conduit, IMC.
3. Underground Conduit: RNC, Type EPC 80-PVC, encased in concrete.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA Type 4X.
B. Indoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed: EMT in mechanical rooms, crawl spaces, mechanical tunnels, and other unfinished areas; Surface Metal Raceway in corridors, classrooms, offices, toilets, and all other finished spaces.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
a. Loading dock.
b. Mechanical rooms.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit.

6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
7. Embedded in or below concrete slab: Rigid Steel Conduit.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings.
2. EMT: compression couplings and connectors.
3. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

18.02 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install raceways level and square and at proper elevations. Insure adequate headroom.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

I. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by the National Electrical Code.

J. 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.

K. Set metal floor boxes level and flush with finished floor surface.

L. Use temporary closures to prevent foreign matter from entering raceways.

M. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

N. Use raceway fittings compatible with raceways and suitable for use and location.

O. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

P. Raceways Embedded in Slabs: Install in middle third of slab thickness, and leave at least 3/4-inch concrete cover. Install conduit below the slab reinforcing.
1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally 18 inches on center to prevent voids in concrete.
3. Conduit larger than 1-inch trade shall not be installed in the slab.
4. Transition to rigid steel conduit before rising above floor.
5. Conduits penetrating the slab shall be spaced a minimum of 4 inches apart.
6. Conduits shall not cross within the slab.

Q. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, on common supports where practical.

2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

R. Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Use insulating bushings to protect conductors.

S. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

T. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

U. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

V. Voice and Data System Raceways, 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements. Provide insulating bushings at all terminations. Comply with EIA/TIA-569, Commercial Building Standards for Telecommunications Pathways and Spaces.

W. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
2. Where otherwise required by CCBC.

X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.

Y. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
2. Where a surface raceway is used to supply a lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each lighting fixture having end-stem suspension.

AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

BB. Installation of Combination Device Wall Enclosures:
1. In each instance where two or more device boxes are generally located in the same vicinity and at the same mounting height, mount those devices in a common multi-gang barriered box appropriate for the device types.
2. Combination receptacle and communications devices (i.e. television, data and receptacle shall be installed in minimum 2 gang boxes with barriers to segregate the systems.

3. Combination devices (i.e. data/voice outlet and normal receptacle) installed in minimum 3 gang box under common wall plate. Provide barriers to segregate systems.

18.03 CLEANING

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Preliminary Acceptance.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

18.04 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Preliminary Acceptance.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260535
ELECTRIC SNOW MELT SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Furnish and install a complete UL Listed system of heaters and components approved specifically for snow and ice melting. Heating cable must be suitable for direct burial in concrete or asphalt. The heat tracing system shall conform to ANSI/IEEE and IEEE Standard 515.1-1995. Compliance with manufacturer's installation instructions in its entirety is required. The electrical contractor shall supply and install a complete snow and ice melting system which shall consist of the following:
   1. Self-regulating, parallel resistance electric heating cables.
   2. Temperature controllers and auxiliary sensors.
   3. Accessory materials such as contactors, pre-punched strapping, junction boxes, etc.
   4. Heating panel and feeders.

B. The extent of the snow and ice melting system is as shown on specification sheets and electrical/architectural drawings.

C. The entire design and installation of the system shall comply with the Electrical Code (current edition) and the requirements of the "Authority Having Jurisdiction".

D. Related Sections include the following:
   1. Division 26 Section "Conductors and Cables."
   2. Division 26 Section "Grounding and Bonding."
   3. Division 26 Section "Raceways and Boxes for Electrical Systems."

B. The Heat Trace Installer shall provide complete engineered heat trace system including drawings, details, electrical data and literature required for a complete system, to be supplied by the manufacturer.

C. System spacing requirements based on supply voltage, application, and location. Generally, the required watt density for a snow melting application in the Midwestern US will be 40 Watts per square foot.
D. The Heat Trace manufacturer shall provide the Layout Drawings in PDF format.

1.01 DRAWING REQUIREMENTS

A. Snow Melt Layout Drawings: Drawings shall be provided, including:
   1. Location/Identification of area to be traced
   2. Area Dimensions
   3. Expansion Joints, Crack Control, Trench Locations
   4. Heater circuit number
   5. Watt Density
   6. Electrical load
   7. Heater catalog numbers
   8. Heater termination points
   9. Start-up Temperature
   10. Pavement profile details
   11. Location of all components
   12. Material list of all components and quantities
B. Snow Melt Installation Detail Drawings: Project Specific Installation Detail Drawings shall be provided including details showing:
   1. Expansion Joint
   2. Crack Control Joint
   3. Trench
   4. Junction Box
   5. Pavement
   6. Sensor
C. Control Panel Drawings: Drawings shall be provided for each control panel and shall include the following:
   1. Physical arrangement and structural detail drawings.
   2. Complete power and control wiring diagrams showing all internal wiring connections for all electrical and instrument components in each control panel. All wires, terminals, and devices shall be numbered and tagged in accordance with the system elementary diagrams.
D. System Wiring Diagram: Project Specific drawings including:
   1. Interconnect of all major components
   2. Assignment of circuiting
   3. Connection of circuit wiring in terminal blocks
   4. Connection of sensor wiring
   5. Connection of external alarm wiring (if applicable)
E. Controller Setpoint Schedule (if applicable) showing the following:
   1. Circuit addresses
   2. Circuit set points
   3. Circuit alarms and settings
   4. Circuit power test cycle time
F. Power distribution panel board schedules (if applicable) showing the following
   1. Heat Tracing Circuit allocation
   2. Breaker size
   3. Voltage and wattage
   4. Operating load amps
G. O&M Manual: Complete installation, operating and maintenance manuals
   1. Product data sheets
   2. Installation and operation manuals
   3. Manufacturers project specific system drawings
   4. Manufacturers site report

1.02 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric snow melting cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.03 QUALITY ASSURANCE

A. 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.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.
   2. Provide one (1) year warranty for all heat trace controllers.

PART 4 - PRODUCTS

4.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide nVent Thermal Management, LLC; Raychem Pyrotenax MI heating cable or a comparable product by one of the following:
   1. Thermon SnoTrace KSR.
   2. BH Thermal Corporation.
   3. Delta-Therm Corporation.

B. Heating Element: HDPE jacketed copper sheathed MI heating cable. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating. The heating cable shall consist of a single conductor surrounded by magnesium oxide insulation with a seamless, LSZH (low smoke zero halogen)-covered, copper sheath and shall operate on line voltage of 480 volts without the use of transformers.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

A. Cable Cover: Tinned-copper braid, and silicone rubber outer jacket.

B. Maximum Operating Temperature (Power On): 33 deg F.

A. Maximum Exposure Temperature (Power Off): 40 deg F.

B. Maximum Operating Temperature: 300 deg F.

A. Capacities and Characteristics:
   1. Maximum Heat Output: 0.10 amps/ft.
   2. Spacing: 9 inches.
   3. Number of Parallel Cables: 2 inches
   1. Volts: 480 V.
   2. Phase: three
   3. Hertz: 60
   4. Full-Load Amperes: 27
   5. Minimum Circuit Ampacity: 30
   6. Maximum Overcurrent Protection: 40 amps

B. The heating cable and termination components shall be UL Listed specifically as electric de-icing and snow-melting equipment.
C. The heating cable shall be of parallel resistance construction capable of being cut to length and terminated in the field.
D. The cable shall provide the heat necessary to melt snow and ice through a semi-conductive polymer heating matrix. The heater shall be covered by a fluoropolymer dielectric jacket, a tinned copper braid for grounding purposes and an overall silicone outer jacket for added protection during installation.
E. The heating cable must reduce power output at elevated temperatures to prevent overheating and system damage if accidentally energized during periods above 40°F.
F. The heater shall operate on a line voltage of 277 Vac without the use of transformers. Voltage rating of the dielectric insulation shall be 600 Vac.
G. Power connections and end seal terminations shall be made in junction boxes as described under Part 6, Installation.
H. Quality assurance test certificates are to accompany each reel of heating cable signed by the manufacturer's Quality Control Officer. Certificates are to indicate cable type, cable rating, voltage rating, test date, batch number, reel number and length of cable, test voltage and test amperage reading.
I. Refer to the manufacturer's "Snow Melting Design Guide" for design details, installation requirements, maximum circuit lengths and accessory information.

10.02 CONTROLS

J. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
K. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
L. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
M. Corrosion-resistant, waterproof control enclosure.
N. Systems with four or more circuits shall utilize a dedicated power distribution and contactor panel provided by the snow melting system manufacturer. Included in each panel will be a main breaker, contactor and 30 mA ground-fault branch circuit breakers. The panel enclosure will be rated for NEMA 3R for outdoors) service. All panel components shall be UL and/or CSA certified.
O. Power to the snow melting circuits will be controlled by an automatic snow sensor designed to control the heating cable load or the coil(s) of a contactor.

10.03 SYSTEM PERFORMANCE

P. Heating cable spacing shall be based on:
    1. Section 6.3, Snow Melting, of the IEEE Standard 515.1- 1995 Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Commercial Applications.
    2. Manufacturer to submit thermal analysis depicting the surface temperature based on ambient temperature and mph winds.
Q. System performance shall be based on heated surface temperatures of 32°F (minimum) during the snow melting process. Start-up in cold concrete shall be used for circuit breaker sizing only.

10.04 ACCESSORIES

R. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
S. Connection Kits – The heating cable shall be factory terminated with a minimum 7 foot cold lead (unheated) length.
T. Group Control (includes power distribution and control) – Pentair SMPG snow melting power distribution and control panel Group snow/ice melting controller shall have a main breaker and

integrated 30-mA, alarming, ground-fault circuit breakers. Use in conjunction with up to six (6) type CIT-1 aerial and/or type SIT-6E slab mounted temperature and moisture sensors.

U. System Listing - The system (heating cable, connection kits, and controller) shall be UL Listed and CSA Certified for snow melting.

V. Warning Labels: Refer to Division 26 Section "Identification for Electrical Equipment."

A. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

PART 12 - EXECUTION

12.01 EXAMINATION

B. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

12.02 INSTALLATION

C. Installation of the snow melting heating cable system to be carried out by an experienced heating cable installer.

D. Comply with manufacturer’s recommendations in the MI Heating Cable Installation and Operation Manual (H57754). The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements

E. Contractor shall have a minimum of 10 years of experience in the installation of such systems.

F. Heating cable shall be installed directly in concrete within 2" to 4" of the finished surface (in asphalt 1½" to 2").

G. In the field, all heating cables shall be meggered with a minimum of 1000 volts DC for MI cable and 2,500 volts DC for self-regulating cable. The following separate field megger readings shall be taken on each self-regulating and each mineral insulated heating cable.
   1. Heating cable shall be meggered when received at jobsite before installation.
   2. Heating cable shall be meggered after installation, but before concrete is poured.
   3. Heating cable shall be meggered while the concrete is poured
   4. Heating cable shall be meggered at final commissioning prior to being energized.
   5. All results must meet manufacturer’s specification.

H. Installer shall follow manufacturer’s installation instructions and design guide for proper installation and layout methods.

I. Power connections and end terminations shall be located in NEMA 4 or 4X junction boxes. Heating cable located between the junction boxes and concrete shall be encased in rigid metal conduit (with protective bushings at each end) which extends 12" into the concrete.

J. Contractor shall provide and install rigid conduit, fittings, and power wiring from transformer to the circuit breaker panel to the heating circuit power termination boxes and from the automatic controller to the circuit breaker panel. Locate the automatic snow detector sensor as indicated on systems drawings provided by the manufacturer.

K. All installations and terminations must conform to the National Electrical Code and any other applicable national or local code requirements.

L. Circuit breakers supplying power to the heat tracing must be equipped with 30 mA minimum ground-fault equipment protection (5 mA GFCI should not be used as nuisance tripping may result).

M. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.

N. Set field-adjustable switches and circuit-breaker trip ranges.

O. Protect installed heating cables, including nonheating leads, from damage.

12.03 CONNECTIONS

P. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

Q. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

12.04 FIELD QUALITY CONTROL

R. Initial start-up and field testing (commissioning) of the system shall be performed by factory technician or factory representative per the owner's requirements.

S. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete. The system shall be commissioned in accordance to the MI Heating Cable Installation and Operation manual. The heating cable circuit integrity shall be tested using a 1000 Vdc megohmmeter. Minimum acceptable insulation resistance shall be 20 megohms. Contractor shall submit to owner results of installation tests required by the manufacturer
   1. Test cables for electrical continuity and insulation integrity before energizing.
   2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

A. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

B. Remove and replace malfunctioning units and retest as specified above.

C. Field Tests And Inspections

13.02 The system shall be commissioned in accordance to the Manufacturer's Installation and Operation manual.

13.03 Field visits to be scheduled at the following interval:

D. Pre-installation training

E. Heating cable shall be meggered after installation, but before concrete is poured

F. Heating cable shall be meggered after concrete pour

G. Final commissioning including controller programming (if applicable)

13.03 The technician shall verify that the controller parameters are set to the application requirements.

13.05 The technician shall verify that the controller alarm contacts are properly connected to the BMS (if applicable)

A. Heating cable shall be tested with a 2,500 Vdc megohmeter (megger) between the heating cable bus wires and the heating cable metallic braid. While a 2,500 Vdc megger test is recommended, the minimum acceptable level for testing is 1,000 Vdc. This test should be performed a minimum of four times:
   1. Prior to installation while the cable is still on reel(s).
   2. After installation of heating cable and completion of circuit fabrication kits but prior to concrete or asphalt placement.
   3. During the placement of concrete or asphalt.
   4. Upon completion of concrete or asphalt placement.

B. The minimum acceptable level for the megger readings is 20 megohms, regardless of the circuit length.

C. Test should be witnessed by the construction manager for the project and the heating cable manufacturer or authorized representative. Results of the megger readings should be recorded and submitted to the construction manager.

END OF SECTION

SECTION 260543
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Contractor shall provide separate manholes and hand holes for both power and low voltage systems.

C. Where a single hand hole is indicated on the drawings which serve both power and low voltage utilities, the hand hole shall be provided with a UL listed divider in order to provide physical separation of such utilities.

1.02 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.

2.02 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. PVC: Poly-Vinyl Chloride conduit.

2.03 SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for handholes, boxes, and other utility structures.
   4. Warning tape.

B. Shop Drawings for Precast or Factory-Fabricated Underground Conduit Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Grounding details.
   5. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   6. Joint details.

B. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

C. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

A. Qualification Data: For professional engineer and testing agency.

B. Source quality-control test reports.

C. Field quality-control test reports.

4.02 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

D. Comply with Chicago Building Code.

5.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

5.03 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

6.02 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

6.03 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 8 – PRODUCTS

8.01 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

1. All ninety degree conduit elbows and conduit stub-ups shall be Rigid Steel Conduit, no exceptions.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

9.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling (Underground Devices Incorperated (847) 205-9000, www.udevices.com).
      a. Duct bank shall be encased in concrete with at least three inches of concrete at the top and bottom and two inches on each side.
      b. A horizontal and vertical separation between the ducts of two inches shall be maintained by installing Underground Devices High Impact Polystyrene Wunpeece Spacers.
      c. Spacers shall be interlocked horizontally only. Along the length of the duct run spacers shall be staggered at least 6 inches vertically and shall be placed at an interval of five spacers per 20 feet or per manufacturer's reccommendations.
   2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
   3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
      a. Color: Red dye added to concrete during batching.
      b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

10.02 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carder Concrete Products.
   2. Christy Concrete Products.
   3. Elmhurst-Chicago Stone Co.
   4. Oldcastle Precast Group.
   5. Riverton Concrete Products; a division of Cretex Companies, Inc.
   6. Utility Concrete Products, LLC.
   7. Utility Vault Co.
   8. Wausau Tile, Inc.

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
   1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
   2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
   3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
      a. Cover Hinges: Concealed, with hold-open ratchet assembly.
      b. Cover Handle: Recessed.
   4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
      a. Cover Hinges: Concealed, with hold-open ratchet assembly.
      b. Cover Handle: Recessed.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: Molded lettering, "ELECTRIC.", "TELEPHONE." Or As indicated on the drawings for each service.

7. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth of 12 inches.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
12. Where power and communication service conduits are routed in parallel to a common piece of equipment or device, the handhole shall be provided with an FHR divider panel and separate access covers in order to maintain code required physical separation of conduits and associated cabling.

13.02 SOURCE QUALITY CONTROL

A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by a independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 17 - EXECUTION

17.01 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.
G. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

H. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.

I. Underground Ducts Crossing Paved Paths, Walks and Driveways/Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

19.02 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
   2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   3. Units in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
   4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

21.02 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

22.02 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
   1. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
   2. Grout end bells into structure walls from both sides to provide watertight entrances.

B. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

C. Sealing and Waterproofing: Provide temporary mechanical waterproof closure/plug at all terminations of ducts that have cables pulled. Provide mechanical waterproof plug on all spare empty ducts at each duct/conduit end. Sealing and waterproofing mechanical plugs shall

withstand at least 15-psig hydrostatic pressure. Sealing and waterproofing system shall be capable of adding and removing cables.

D. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

E. Cleaning: Underground conduit duct shall completely dry and free from water and debris prior to installation of cables and nylon pull ropes. Clean entire length of all underground electrical conduit ducts with compressed air. Temporarily cover all ends of conduit ducts in order to prevent water and debris infiltration during the entire length of construction.

F. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

B. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

25.02 GROUNDING

C. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

25.03 FIELD QUALITY CONTROL

D. Perform the following tests and inspections and prepare test reports:
1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Correct deficiencies and retest as specified above to demonstrate compliance.

25.04 CLEANING

F. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

G. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

2 GENERAL

1. RELATED DOCUMENTS
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. SUMMARY
   1. Section Includes:
      1. Color and legend requirements for raceways, conductors, and warning labels and signs.
      2. Labels.
      3. Bands and tubes.
      4. Tapes and stencils.
      5. Tags.
      6. Signs.
      7. Cable ties.
      8. Paint for identification.
      9. Fasteners for labels and signs.
3. ACTION SUBMITTALS
   1. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
   2. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
   3. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
   4. Delegated-Design Submittal: For arc-flash hazard study.

3 PRODUCTS

1. PERFORMANCE REQUIREMENTS
   1. Comply with ASME A13.1 and IEEE C2.
   2. Comply with NFPA 70.
   3. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
   4. Comply with ANSI Z535.4 for safety signs and labels.
   5. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
   6. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
   7. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
      1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. COLOR AND LEGEND REQUIREMENTS
   1. Raceways and Cables Carrying Circuits at 600 V or Less:
      1. Black letters on an orange field.
      2. Legend: Indicate voltage and system or service type.
   2. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
      1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
      2. Colors for 208/120-V Circuits:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

3. Colors for 240-V Circuits:
    1. Phase A: Black.
    2. Phase B: Red.
4. Colors for 480/277-V Circuits:
    1. Phase A: Brown.
    2. Phase B: Orange.
    3. Phase C: Yellow.
5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

3. Raceways and Cables Carrying Circuits at More Than 600 V:
    1. Black letters on an orange field.
    2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
4. Warning Label Colors:
    1. Identify system voltage with black letters on an orange background.
5. Warning labels and signs 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. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
6. Equipment Identification Labels:
    1. Black letters on a white field.

3. LABELS
    1. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
    2. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
    3. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible label with acrylic pressure-sensitive adhesive.
        1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
        2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
        3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
    4. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
        1. Minimum Nominal Size:
            1. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
            2. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
            3. As required by authorities having jurisdiction.

4. BANDS AND TUBES
    1. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
    2. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

5. TAPES AND STENCILS
   1. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
   2. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
   3. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.
   4. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with [black and white] [yellow and black] stripes and clear vinyl overlay.
   5. Underground-Line Warning Tape:
      1. Tape:
         1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications 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 degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
      2. Color and Printing:
         1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
         2. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
         3. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
      3. Tag: Type I:
         1. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
         2. Width: 3 inches (75 mm).
         3. Thickness: 4 mils (0.1 mm).
         4. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
         5. Tensile according to ASTM D 882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
      4. Tag: Type II:
         1. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
         2. Width: 3 inches (75 mm).
         3. Thickness: 12 mils (0.3 mm).
         4. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
         5. Tensile according to ASTM D 882: 400 lbf (1780 N) and 11,500 psi (79.2 MPa).
   6. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).
6. TAGS
   1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
   2. Nonmetallic Preprinted Tags: Polyethylene tags, [0.015 inch (0.38 mm)] [0.023 inch (0.58 mm)] thick, color-coded for phase and voltage level, with factory [screened] [printed] permanent designations; punched for use with self-locking cable tie fastener.
   3. Write-on Tags:
      1. Polyester Tags: [0.010 inch (0.25 mm)] [0.015 inch (0.38 mm)] <Insert dimension> thick, with corrosion-resistant grommet and cable tie for attachment.
      2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
      3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

7. SIGNS
   1. Baked-Enamel Signs:
      1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
      2. 1/4-inch (6.4-mm) grommets in corners for mounting.
      3. Nominal Size: 7 by 10 inches (180 by 250 mm).
   2. Metal-Backed Butyrate Signs:
      1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
      2. 1/4-inch (6.4-mm) grommets in corners for mounting.
      3. Nominal Size: 10 by 14 inches (250 by 360 mm).
   3. Laminated Acrylic or Melamine Plastic Signs:
      1. Engraved legend.
      2. Thickness:
         1. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
         2. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
         3. Engraved legend with black letters on white face.
         4. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
         5. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
8. CABLE TIES
   1. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
      1. Minimum Width: 3/16 inch (5 mm).
      2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
      3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
      4. Color: Black, except where used for color-coding.
   2. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
      1. Minimum Width: 3/16 inch (5 mm).
      2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
      3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
      4. Color: Black.
   3. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
      1. Minimum Width: 3/16 inch (5 mm).
      2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
      3. UL 94 Flame Rating: 94V-0.
      4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
      5. Color: Black.
9. MISCELLANEOUS IDENTIFICATION PRODUCTS
   1. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
   2. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

4. EXECUTION

1. PREPARATION
   1. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

2. INSTALLATION
   1. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
   2. Install identifying devices before installing acoustical ceilings and similar concealment.
   3. Verify identity of each item before installing identification products.
   4. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
   5. Apply identification devices to surfaces that require finish after completing finish work.
   6. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
   7. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
      1. Secure tight to surface of conductor, cable, or raceway.
   8. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
      1. Secure tight to surface of conductor, cable, or raceway.
   9. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
   10. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
   11. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
      1. "EMERGENCY POWER."
      2. "POWER."
      3. "UPS."
   12. Vinyl Wraparound Labels:
      1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
      2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
   13. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
   14. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
   15. Self-Adhesive Labels:
      1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
      2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   16. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
   17. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
   18. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
   19. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
      1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

20. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

21. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
22. Underground Line Warning Tape:
    1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
    2. Limit use of underground-line warning tape to direct-buried cables.
    3. Install underground-line warning tape for direct-buried cables and cables in raceways.
23. Metal Tags:
    1. Place in a location with high visibility and accessibility.
    2. Secure using[general-purpose cable ties.
24. Nonmetallic Preprinted Tags:
    1. Place in a location with high visibility and accessibility.
    2. Secure using UV-stabilized cable ties.
25. Write-on Tags:
    1. Place in a location with high visibility and accessibility.
    2. Secure using general-purpose cable ties.
26. Baked-Enamel Signs:
    1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
    2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
27. Metal-Backed Butyrate Signs:
    1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
    2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
28. Laminated Acrylic or Melamine Plastic Signs:
    1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
    2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
29. Cable Ties: General purpose, for attaching tags, except as listed below:
    1. Outdoors: UV-stabilized nylon.
    2. In Spaces Handling Environmental Air: Plenum rated.

3. IDENTIFICATION SCHEDULE

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
2. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
3. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.
    1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.
4. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.
    1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

5. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
    1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
6. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
    1. "EMERGENCY POWER."
    2. "POWER."
    3. "UPS."
7. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
    1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
8. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
9. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
10. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
11. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
12. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
    1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
13. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
14. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
    1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
    2. Wall surfaces directly external to raceways concealed within wall.
    3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
15. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
16. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
17. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
    1. Apply to exterior of door, cover, or other access.
    2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
        1. Power-transfer switches.
        2. Controls with external control power connections.
18. Arc Flash Warning Labeling: Self-adhesive labels.
19. Operating Instruction Signs: Baked-enamel warning signs.
20. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

21. Equipment Identification Labels:
    1. Indoor Equipment: Baked-enamel signs.
    2. Outdoor Equipment: Laminated acrylic or melamine sign.
    3. Equipment to Be Labeled:
        1. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
        2. Enclosures and electrical cabinets.
        3. Access doors and panels for concealed electrical items.
        4. Switchboards.
        5. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
        6. Substations.
        7. Emergency system boxes and enclosures.
        8. Motor-control centers.
        9. Enclosed switches.
        10. Enclosed circuit breakers.
        11. Enclosed controllers.
        12. Variable-speed controllers.
        13. Push-button stations.
        14. Power-transfer equipment.
        15. Contactors.
        16. Remote-controlled switches, dimmer modules, and control devices.
        17. Battery-inverter units.
        18. Power-generating units.
        19. Monitoring and control equipment.
        20. UPS equipment.

END OF SECTION

SECTION 260813
TESTING OF ELECTRICAL SYSTEMS

PART 19 - GENERAL
19.01 SUMMARY

A. Section includes requirements for Electrical Testing including, but not limited to:
    1. Testing of electrical components and systems.
        a. Insulation resistance test.
        b. Continuity test.
        c. Voltage test.
        d. Phase relationship verification.
    2. Correction of defective components or systems.
    3. Retest of corrected components, systems.

19.02 SUBMITTALS

A. Test reports: Submit six (6) copies of all test reports to Architect/Engineer of Record (3 copies), General Contractor (1).
    1. Type each test report on 8-1/2” x 11” paper. Include:
        a. Project title and location.
        b. Test performed.
        c. Data performed
        d. Test equipment used.
        e. Contractor’s name, address and telephone number.
        f. Testing firm’s name, address and telephone number.

g. Names and tittles of persons:
   1) Performing the test.
   2) Observing test
h. Statement verifying each test.
i. Nameplate data from each motor and equipment item tested.
j. Test results.
k. Retest results after correction of defective components, systems.
l. Dates and time of test.

2. For each copy, assemble all test reports and bind them in a folder. Label each folder, "Electrical Test Reports".

PART 20 - PRODUCTS

20.01 MATERIALS:

A. Furnish all equipment, manpower and casual labor to perform specified testing.

PART 21 - EXECUTION

21.01 PREPARATION

A. Ensure that all electrical work is completed and ready for testing.
B. Disconnect all devices or equipment that may be damaged by application of test voltages, voltage or reversed phase sequence or other procedures.

21.02 TESTING:

A. Conduct tests and adjust equipment to verify compliance with specified performance.

21.03 INSULATION RESISTANCE TESTS

A. Resistance measured: line-to-ground.
B. Perform testing on the following items:

Item Tested	Min. Acceptance Voltage of Test	Resistance in Megohms
No. 2. and Larger Cables (600v)	1000v	50

21.04 CONTINUITY TESTS:

A. Test branch circuits and control circuits to determine continuity of wiring and connection.

21.05 VOLTAGE TESTS

A. Make and record voltage tests and record at the following listed points. Conduct tests under normal load conditions.
   1. Terminals of all motors.
   2. Terminals of all equipment, i.e., UPS, refrigeration compressors, etc.

21.06 PHASE RELATIONSHIP

A. Examine connections to equipment for proper phase relationships. Verify proper motor rotation.

21.07 CORRECTION OF DEFECTS

A. When tests disclose any unsatisfactory workmanship or equipment furnished under this Contract, correct defects and retest. Repeat tests until satisfactory results are obtained.
B. When any wiring or equipment is damaged by tests, repairs or replace such wiring or equipment. Test repaired items to ensure satisfactory operation.

21.08 CONTRACTOR STARTUP AND REPORTING

A. Contractor shall prepare and submit a complete set of test reports as outlined in this section.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 22 - GENERAL

22.01 SUMMARY

A. Section includes the following lighting control devices:
   1. Time clocks.
   2. Outdoor and indoor photoelectric switches.
   3. Indoor occupancy/vacancy sensors.
   4. Lighting contactors
   5. Outdoor motion sensors.

22.02 LIGHTING CONTACTORSDEFINITIONS

A. LED: Light-emitting diode.
B. PIR: Passive infrared.

22.03 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Manuals: Provide a collection of manufacturer recommended operation and maintenance practices for each type of product including, but not limited to:
   1. Tools required.
   2. Acceptable cleaners and recommended cleaning practices.
   3. Replacement parts list.
   4. Manufacturer service department contact information.
   5. Submittal data.
   6. Intended operation narrative.

22.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the National Electrical Code, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with National Building Code.

22.05 DELIVERY, STORAGE AND HANDLING

A. Effectively protect all materials, accessories, and components form any damage or injury from the time of fabrication until final Owner acceptance.
B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
C. Store equipment in spaces with environments controlled within manufacturer’s ambient temperature and humidity tolerances for non-operating equipment.

22.06 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 23 - PRODUCTS

23.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Outdoor Photoelectric Switches
   a. Sensor Switch, Inc.
   b. Watt Stopper (The)
   c. Acuity Controls™ n-Light.
   d. ETC
2. Indoor Occupancy/vacancy Sensors
   a. Sensor Switch, Inc.
   b. Watt Stopper (The)
   c. Acuity Controls™ n-Light.
3. Lighting Contactors
   a. Sensor Switch, Inc.
   b. Watt Stopper (The)
   c. Acuity Controls™ n-Light.
   d. ETC

23.02 OUTDOOR PHOTOELECTRIC SWITCHES

A. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: 15-second minimum, to prevent false operation.
   3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
   4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

23.03 INDOOR PHOTOELECTRIC SWITCHES

A. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
   1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   2. Relay Unit: Dry contacts rated for 20 -A ballast load at 120- and 277-V ac, for 13 -A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA and Class 2 power source as defined by the National Electrical Code.
   3. Light-Level Monitoring Range: 10 to 200 fc for lighting control of general interior spaces, 100 to 1000 fc for lighting control of interior spaces with large window areas, including atriums and corridors with an adjustment for turn-on and turn-off levels within that range.
   4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
   5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

23.04 INDOOR OCCUPANCY/VACANCY SENSORS

A. General:
   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes. Where multiple occupancy sensors occur within the same space, connect sensors together to control the lights as a unit.
   2. Coordination:
      a. Coordinate sensor load rating to load controlled. Provide any power-packs, relays and control components necessary for a fully functional complete system.
      b. Provide occupancy sensors compatible with high- inrush electronic ballasts, compact fluorescent lamps, LED drivers and low-voltage relay control systems.

c. For dual-technology sensors, coordinate both technologies within the same sensor to have the same coverage area.

3. Sensitivity: Provide either self-adjusting occupancy sensors or provide all necessary contractor start-up (adjustments and fine tuning) of each occupancy sensor prior to Owner Acceptance.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box. Suitably enclose sensor for return air plenum conditions where applicable.
   b. Protection: Provide a vandal resistant coated-steel wire cage around occupancy sensors used in areas subject to damage or vandalism.
   c. Obstructions: Provide ceiling mounted sensors anywhere there is likely to be permanent or temporary obstructions (i.e., stalls, bookcases, coat racks) that limit the sensor's ability to detect movement.
   d. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

B. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

C. Ultrasonic Type: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
6. Provide sensors operating at a minimum of 32 kHz and a maximum of 98dB.
7. Locate sensors away from areas with strong air currents such as adjacent to HVAC diffusers.
8. Layout shall account for sensitivity adjustments below maximum and any absorptive materials such as carpeting or material covered partitions.

D. Microphonic Type: Detect occupancy by sensing noise level changes in the space.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
6. Do not use the microphonic sensing technology to initiate an ON sequence.
7. Provide automatic gain control.

23.05 OUTDOOR MOTION SENSORS (PIR)

A. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as rain-tight according to UL 773A.
   1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   2. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
      b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   3. Bypass Switch: Override the on function in case of sensor failure.
   4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.

B. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.

C. Detection Coverage: Up to 35 feet, with a field of view of 180 degrees.

23.06 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.

PART 24 - EXECUTION

24.01 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

24.02 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables for Electrical Systems." Minimum conduit size shall be 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Provide CAT 5e cable in conduit for low voltage lighting control of all lighting fixtures. Provide power packs, relay control panels, etc. for a complete low voltage lighting control system.

24.03 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

24.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

24.05 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

24.06 CLEANING

A. The contractor shall remove all paint spatters and other spots, dirt and debris from the equipment. Clean equipment and devices internally and externally using methods and materials recommended by the manufacturer.

24.07 CONTRACTOR STARTUP AND REPORTING

A. Contractor shall prepare and submit a complete set of record drawings, operation and maintenance data and certificates as outlined in this Section.

B. Install any necessary initial lighting controls settings into the field devices. Coordinate schedules with the Owner so that a complete schedule is available at the time of commissioning. Electrical Contractor shall be responsible for schedule updates until panels are turned over to the Owner. Provide final system programming documents including final operating schedules, wiring documentation and programmable device and system switch operation data.

C. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Training shall last a minimum of 4 hours and at the end of the session, the owner’s maintenance personnel shall be thoroughly instructed in the proper operation of the system.

24.08 COMMISSIONING AND DEMONSTRATION

A. After system checkout and adjustment, the contractor shall operate the system for the review of the owner and architect. Necessary adjustments or modifications shall be made as required by the owner or architect.

END OF SECTION

SECTION 262726
WIRING DEVICES

PART 25 - GENERAL

25.01 SUMMARY

A. Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Wall-box motion sensors.
   3. Snap switches and wall-box dimmers.
   4. Solid-state fan speed controls.
   5. Wall-switch.
   6. Communications outlets.
   7. USB Charger Receptacles.

25.02 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. UTP: Unshielded twisted pair.

25.03 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
C. Field quality-control test reports.
D. Operation and Maintenance Data: Wiring devices shall be provided with all manufacturers' packing label warnings and instruction manuals that include labeling conditions. Provide a collection of manufacturer recommended operation and maintenance practices for each type of product including, but not limited to:
   1. Tools required.
   2. Acceptable cleaners and recommended cleaning practices.
   3. Replacement parts list.
   4. Manufacturer service department contact information.
   5. Submittal data.
   6. Intended operation narrative.

25.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the National Electrical Code, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 101.
D. Comply with National Electrical Code.

25.05 DELIVERY, STORAGE AND HANDLING

A. Effectively protect all materials, accessories, and components form any damage or injury from the time of fabrication until final Owner acceptance.
B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
C. Store equipment in spaces with environments controlled within manufacturer’s ambient temperature and humidity tolerances for non-operating equipment.

25.06 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 26 - PRODUCTS

26.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Wiring Devices:
      a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
      b. Hubbell Incorporated; Wiring Device-Kellems
      c. Leviton Mfg. Company Inc.
      d. Pass & Seymour/Legrand; Wiring Devices & Accessories

26.02 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: “DECORATOR” style. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 and Federal Specification W-C-596. Pre-wired pigtail connectors that accommodate Fed Spec receptacles are approved. Pigtail connectors must be crimped and welded terminal right-angle application connector.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Legrand; PT26352W-TR (duplex – use with PTRA6STRNA prewired pigtail connector).
      b. Eaton; TR6352W (duplex).
      c. Hubbell; DR20WHITR (duplex).

26.03 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Units shall fit in a 2-3/4” deep outlet box without an adapter.
B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

26.04 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.
B. Switches, 120/277 V, 20 A:
C. Pilot Light Switches, 20 A:
   1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
D. Key-Operated Switches, 120/277 V, 20 A:
   1. Description: Single pole, with factory-supplied key in lieu of switch handle.
E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

26.05 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
C. Incandescent and LED Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. 600 W; dimmers shall require no derating when ganged with other devices.
D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

26.06 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
   1. Continuously adjustable slider, 5 A.
   2. Three-speed adjustable slider, 1.5 A.

26.07 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel except as noted otherwise on drawings.
   3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

26.08 USB CHARGER RECEPTACLES

A. Description: Commercial, UL Fed Spec USB Charger Tamper-Resistant Receptacle, Two USB Type 2.0 Ports 3 Amp, 5 Volt DC, 15 or 20 Amp, 125 Volt AC Decorator Duplex. Green LED indicator to show USB power available. Impact and chemical resistant. Flus fit design.

26.09 FINISHES

A. Color:
1. Wiring Devices Connected to Normal Power System: White, or as directed by the architect and required by National Electrical Code or device listing.
2. Wiring Devices connected to automatic control system (Controlled Receptacles): White, Green or as selected by architect.
3. Wiring Devices Connected to Emergency Power System: Solid Red.

PART 27 - EXECUTION

27.01 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. 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 the 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.

C. Conductors:
1. Do not strip insulation from conductors until just 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 National Electrical Code, 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. Pig-tailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they 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, 2/3 to 3/4 of the way around terminal screw.
6. Modular wiring devices are seen as an acceptable alternative at the discretion of the contractor. Receptacles must meet UL498 and Federal Specification WC-596

requirements. Switches must meet UL20 and Federal Specification WC-896 requirements. Prewired terminal right angle application pigtail connectors must be crimped and welded.

7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

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. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

G. 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, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

27.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
2. Switches: Where 3 or more switches are ganged, and elsewhere where indicated, identify each switch with approved legend engraved with black-filled lettering on face of wall plate.

27.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
3. Test Wiring Devices: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.

B. 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 not acceptable.
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. The 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.

C. Replace damaged or defective components.

27.04 CLEANING

A. The contractor shall remove all paint spatters and other spots, dirt and debris from the equipment. Clean equipment and devices internally and externally using methods and

materials recommended by the manufacturer. Replace stained or improperly painted wall plates or devices.

27.05 CONTRACTOR STARTUP AND REPORTING

A. Contractor shall prepare and submit a complete set of record drawings, test reports, operation and maintenance data and certificates as outlined in this Section.

27.06 COMMISSIONING AND DEMONSTRATION

A. After system checkout and adjustment, the contractor shall operate the system for the review of the owner and architect. Necessary adjustments or modifications shall be made as required by the owner or architect.

END OF SECTION

SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 28 - GENERAL

28.01 SUMMARY

A. Section includes the following individually mounted, enclosed switches and circuit breakers rated 600V AC and less:
   1. Molded-case circuit breakers.
   2. Molded-case switches.
   3. Enclosures.

28.02 DEFINITIONS

A. GD: General duty.
B. GFCI: Ground-fault circuit interrupter.
C. HD: Heavy duty.
D. RMS: Root mean square.
E. SPDT: Single pole, double throw.

28.03 REFERENCES

A. International Electrical Testing Association
   1. NETA, ATS – 1999; Electrical Testing Specifications for Electrical Power Distribution Equipment and Systems
B. National Electrical Manufacturers Association
   1. NEMA 250-97: Enclosures for Electrical equipment (1000V Maximum)
   2. NEMA 1-99: Molded Case Circuit Breakers and Molded Case Switches
   3. NEMA FU 1-86: Low Voltage Cartridge Fuses
   4. NEMA KS 1-01: Enclosed and Miscellaneous Distribution Equipment Switches (600Volts Maximum)
   5. NEMA PB 1.1-96: General Instructions for proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
   6. NEMA PB 2.1-96: General Instructions for proper Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less
C. Underwriters Laboratories
   1. UL 486A: Wire connectors and soldering lugs for use with copper conductors
   2. UL 98: Enclosed and Dead-Front Switches.
   3. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
   4. UL 977: Fused Power Circuit Devices
   5. UL 1053: Ground Fault Sensing and Relaying Equipment

28.04 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, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current rating.
   4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   5. Time current curves.
   6. Let-through current curves for circuit breakers with current limiting characteristics.
   7. Coordination charts, tables and related data.

B. Shop Drawings: Wiring Diagrams detailing power, signal, and control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Field quality-control test reports including the following:
   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.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Sections "Closeout Procedures" and "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

28.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the National Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with the National Electrical Code.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

28.06 DELIVERY, STORAGE AND HANDLING

A. Store enclosed switches and circuit breakers indoors in clean and dry space with uniform temperature to prevent condensation. Protect enclosed switches and circuit breakers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed switches and circuit breakers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials. Install electric heating of sufficient wattage to prevent condensation.

C. Deliver in factory shipping cartons.

D. Handle enclosed switches and circuit breakers to avoid damage.

28.07 COMPATIBILITY

A. All protective devices in new assemblies shall be of the same manufacturer except for special applications of proprietary types to maximize single-source responsibility.

28.08 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 6600 feet.

28.09 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 29 - PRODUCTS

29.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control .
   3. Siemens Energy & Automation, Inc.
   4. Square D/Group Schneider.

29.02 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded-Case Circuit Breaker: NEMA AB 1, 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. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with 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^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
   5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
   6. GFCI Circuit Breakers: Single- and two-pole configurations with 5 and 30-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in 16 "Electrical Power Monitoring and Control."
   6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   8. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

D. Molded-Case Switch Accessories:
1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.
7. Test kit for each type of solid state breaker.
8. Handle extensions.

E. Additional accessories:
1. Provide breaker accessories for general operation and maintenance of specified breakers. Include items listed below and items recommended by manufacturer:
   a. Handle extensions for devices not mounted in panelboards.
   b. Special adjustment tools.
2. Provide quantities of circuit protective accessories in locations necessary for effective general operation.

29.03 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 30 - EXECUTION

30.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

30.02 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base. Support enclosures independent from stud partitions.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components. Provide quantities of the circuit protective devices accessories in locations necessary for the effective general operations of the facility.

30.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

30.04 CONTROL WIRING INSTALLATION

A. Install wiring between OCPDs and control/indication devices as specified in Division 26 Section "Conductors and Cables for Electrical Systems."

30.05 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

B. Adjust operating mechanisms for free mechanical movement.

30.06 DEMONSTRATION

A. Training: Arrange and pay for the services of factory-authorized service representative to demonstrate OCPDs and train Owner's maintenance personnel.

B. Conduct a minimum of one half day of training in operation and maintenance as specified in the Division 01 Sections "Closeout Procedures" and "Demonstration and Training." Include both classroom training and hands on equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.

30.07 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

30.08 CONTRACTOR STARTUP AND REPORTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

END OF SECTION

SECTION 265119
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.
   3. Emergency lighting units.
   4. Illuminated exit signs.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating.
E. LED: Light-emitting diode.
F. Lumen: Measured output of lamp and luminaire, or both.
G. Luminaire: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps or LED modules, and parts required to distribute the light, position and protect lamps or LED modules, and connect lamps or LED modules to the power supply.
H. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery. They are also known as an emergency light set. Emergency lighting units are available with and without integral heads.
I. UL: Underwriter's Laboratories, Inc.

1.04 SYSTEM DESCRIPTION

A. The interior lighting system shall include all lighting fixtures, lamps or LED modules, switches, mounting, wiring, control equipment, and accessories required for complete system, whether or not they are indicated or specified, as indicated in the Drawings and as specified.
B. The lighting fixture schedules in the Drawings indicate manufacturer, fixture design, appearance and performance desired.
C. Verify locations of light fixtures indicated in Drawings and coordinate with other reference data and materials as required prior to installation to ensure locations will not interfere with other work. Verify space above luminaires and confirm non-interference with other equipment, such as ducts, pipes, conduit and cabling, and openings. Alert Architect and Board Authorized Representative in writing to non-standard modifications required for compliance with the Contract Documents and for installation to coordinate with ceiling system before proceeding with the Work.
D. Verify dimensions. Where discrepancies are found within the Contract Documents, or additional information is required, immediately contact Architect for clarifications and additional information.
E. Coordinate installation of lighting system with other trades to prevent delays in the Work and to ensure the lighting fixtures and supports will not be damaged by subsequent construction operations.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture

type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Lighting luminaires.
   2. Suspended ceiling components.
   3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
   4. Structural members to which equipment and or luminaires will be attached.
   5. Initial access modules for acoustical tile, including size and locations.
   6. Items penetrating finished ceiling, including the following:
      a. Other luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, 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.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all LED fixtures types used on Project; use ANSI and manufacturers' codes.

1.08 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: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.09 QUALITY ASSURANCE

A. 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 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Regulatory Requirements:
   1. Comply with the City of Clarendon Hills Building Code.
   2. Comply with EPA, State of Illinois, and City of Clarendon Hills regulations for proper recycling or disposal of existing lamps and ballasts removed from the Site.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of lighting fixtures indicated to extend in continuous, wall to wall installation. Provide field, or established, dimensions to luminaire manufacturer in sufficient time so not to cause delays in the Work.

C. Coordinate installation of lighting fixtures to allow for the recommended "burn-in" periods for the lamps installed.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.12 WARRANTY

A. Manufacturer’s Warranty: Submit a written warranty, beginning from date of Preliminary Acceptance / Substantial Completion, and executed by the Contractor, manufacturer, and Installer agreeing to repair or replace products or components that fail in materials or workmanship within the specified warranty period. Failures shall include, but not be limited to, deterioration of metal finishes.

B. Manufacturer’s Warranty for Lamps: Submit a written warranty, beginning from date of Preliminary Acceptance / Substantial Completion, and executed by the Contractor, manufacturer, and Installer agreeing to repair or replace products or components that fail in materials or workmanship, f.o.b. the nearest shipping point to the Site, within the manufacturer’s specified warranty period.

C. Manufacturer’s Warranty for LED Luminaires: Submit a written warranty, beginning from date of Preliminary Acceptance / Substantial Completion, and executed by the Contractor, manufacturer, and Installer agreeing to replace products or components that fail in materials or workmanship within the specified warranty period. Failures shall include, but not be limited to, a failure of the LED modules or LED drivers.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

2.02 LUMINAIRE REQUIREMENTS

D. 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.

E. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

F. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

G. Recessed Fixtures: Comply with NEMA LE 4.

H. Lamp base complying with ANSI C81.61 or IEC 60061-1.

I. CRI of minimum 80. CCT of 3000 K.

J. Rated LED board and driver life of min 50,000 hours.

K. Fixture dimmable from 100 percent to 10 percent of maximum light output.

L. Internal driver.

M. Nominal Operating Voltage: 120 V ac
   1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

N. Air-Handling Light Fixtures:

O. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear anodized or powder-coat finish.

P. Housing and heat sink rated to the following:
   1. Class 1, Division 2 Group(s) A.
   2. NEMA 4X.
   3. IP 54.
   4. IP 66.
   5. Marine and wet locations.
   6. CSA C22.2 No 137.

2.03 SURFACE MOUNT, LINEAR

Q. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Refer to Schedule in the Drawings.

R. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

2.04 MATERIALS

S. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

T. 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.

U. Diffusers and Globes:
   1. Prismatic acrylic, UV-stabilized acrylic
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

V. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear anodized finish.

W. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
      a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.05 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.06 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in 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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.07 EXIT SIGNS

A. General: Comply with UL 924 and the National Electrical Code for sign colors, visibility, luminance, and lettering size.
   1. Edge-Glow type fixtures.
B. Internally Lighted Signs:
   1. Lamps for AC Operation: LED's, 70,000 hours minimum rated lamp life.
   2. Self-Powered LED 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, constant current type with integral sealed transfer relay.
      c. Operation: Relay automatically energizes LED module from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects LED modules 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. Pilot Light: Indicates when the battery charger is functioning, when tied to the normal source.
      f. Low Battery Disconnect: Provide a device and/or related circuitry that shall automatically disconnect the battery and protect it from deep/over discharge.
      g. Shall consume 5 watts of AC power, or less, per face under normal operating conditions.

2.08 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924 and the Chicago Electrical Code.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. Pilot Light: Indicates when the battery charger is functioning, when tied to the normal source.

6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
C. Install lamps in each luminaire.
D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.
F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
B. Luminaire will be considered defective if it does not pass operation tests and inspections.
C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied

conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 265600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:
   1. Exterior luminaires and their associated LED modules, drivers and accessories.
   2. Poles, luminaire support structures and their associated accessories.

1.02 DEFINITIONS

A. ANSI: American National Standards Institute.
B. Average Rated LED Module Life: The period of time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
C. CCT: Correlated color temperature.
D. CRI: Color-rendering index.
E. IES: Illuminating Engineering Society of North America.
F. Fixture: A complete lighting unit. Fixtures include LED modules and parts required to distribute the light, position and protect LED modules, and connect them to the power supply.
G. Luminaire: A complete lighting assembly or product consisting of not less than a light source(s) and related devices to position the light source(s), housing or enclosure, light source control and optics and light source power supply control device(s).
H. Pole: Luminaire support structure, including tower used for large area illumination.
I. Solid State Lighting/Luminaires: Light sources and their associated luminaires that produce light (radiant energy) without the use of electrical filaments, excited gas or plasma, such as LED, OLED, or PLED.
J. UL: Underwriter’s Laboratories, Inc.

1.03 SYSTEM DESCRIPTION

A. The exterior lighting system shall include all lighting fixtures, LED modules, switches, mounting, wiring, control equipment, and accessories, whether or not they are indicated or specified, required for a complete system, as indicated in the Drawings and as specified.
B. The lighting fixture schedules in the Drawings indicate manufacturer, fixture design, appearance and performance desired.
C. Verify locations of light fixtures indicated in Drawings and coordinate with other reference data and materials as required prior to installation to ensure locations will not interfere with underground utilities or openings. Alert Architect and Commission Authorized Representative in writing to non-standard modifications required for compliance with the Contract Documents prior to proceeding with the Work.
D. Where discrepancies are found within the Contract Documents, or additional information is required, immediately contact Architect for clarifications and additional information.
E. Coordinate installation of lighting system with other trades to prevent delays in the Work and to ensure the lighting fixtures and supports will not be damaged by subsequent construction operations.

1.04 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.

C. Ice Load: Load of 3 lbf/sq. ft. applied as stated in AASHTO LTS-4.

D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for poles exceeding 50 feet in height is 110 mph.
2. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph.

1.05 SUBMITTALS

A. Action Submittals:

1. General: Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation used in the Drawings and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals that do not indicate option data where multiple selections exist will be returned without being reviewed.
2. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation used in the Drawings and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals that do not indicate option selection where multiple selections exist will be returned without review. Include data on features, accessories, finishes, and the following:
    a. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
    b. Details of attaching luminaires and accessories.
    c. Details of installation and construction.
    d. Luminaire materials such as finish and color information.
    e. Photoelectric relays.
    f. LED Drivers: Include information as to input watts. Indicate mounting distance limitation and standard wire sizes for remote drivers.
    g. LED modules, per luminaire tag, including life, output, and energy-efficiency data.
    h. Materials, dimensions, accessories and finishes of poles.
    i. Photometric data based on laboratory tests of each luminaire type, complete with indicated LED modules, drivers, and accessories.
    j. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
    k. Pole and support structure anchor bolt information.
    l. Manufactured pole foundations, if any.
3. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
    a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include details that cannot be adequately represented to the satisfaction of the Architect in Product Data.
    b. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
    c. Wiring Diagrams: For power, signal, and control wiring.
    d. Photometric data, certified by the manufacturer in accordance with the recommended practices of the IES.
    e. Quantity and type of LED modules.

B. Informational Submittals:

1. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification

shall be based on design calculations by a State of Illinois Registered Structural Engineer.

2. Warranty: Sample of special warranty.

C. Closeout Submittals:

1. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals. Include manufacturers' recommended maintenance practices for each fixture type including, but not limited to, the following:
   a. Tools required.
   b. Acceptable cleaners and recommended cleaning practices.
   c. Replacement parts list.
   d. Manufacturer service department contact information/Qualified Service Agencies.
   e. Submittal data.
   f. Operation data.
   g. Intended operation narrative.
2. Record Drawings: Submit record drawings of the actual installation within thirty (30) days of date of Preliminary Acceptance / Substantial Completion.
3. Re-Commissioning Data: Submit manual containing all information required for re-commissioning of the installations.
   a. Submit two (2) copies of manual within thirty (30) days of date of Preliminary Acceptance / Substantial Completion.
   b. Submit re-commissioning manuals in heavy-duty, 3-ring binders. Submit manuals in accordance with Division 01 Section "Operations and Maintenance Data."

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the National Electrical Code by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

B. Solid State Lighting/Luminaires:

1. Luminous flux, luminaire efficiency and chromaticity shall be tested, measured and reported in accordance with the most current versions of IES documents LM-79 and LM-80.
2. Chromaticity ranges for "white light" products, with various correlated color temperatures, shall be provided in accordance with ANSI/NEMA-C78.377.
3. Drivers and power supplies shall be provided in accordance with the requirements of ANSI/NEMA-C82.SSL1, and their maximum allowable harmonic emission limits shall be in accordance with ANSI/NEMA-C82.77.
4. Shall be provided with a U.S. Department of Energy (DOE) "Lighting Facts "label indicating their specific performance characteristics, tested and reported in accordance with the requirements of the most current version of IES LM-79.

C. Regulatory Requirements: Comply with the City of Clarendon Hills Building Code.

D. Commissioning: When required for the Project, Contractor shall assign representative(s) with expertise and authority to act on its behalf. The representative(s) shall perform commissioning activities including, but not limited to, the following:

1. Review submittals relative to exterior lighting systems being commissioned.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12-inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Handle poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4-inch deep. Do not apply tools to section of pole to be installed below ground line.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation.

E. Deliver exterior lighting fixtures individually wrapped in factory-fabricated fiber Commission type containers or equivalent.

F. Handle exterior lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures; replace and return damaged units to equipment manufacturer.
G. Store lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather and construction traffic.

1.08 WARRANTY

A. Manufacturer's standard Warranty: Submit a written warranty, beginning from date of Preliminary Acceptance / Substantial Completion, and executed by the Contractor, manufacturer, agreeing to replace products or components that fail in materials; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within the specified warranty period. Damage due to lightning, hail, vandalism, abuse, or unauthorized repairs or alterations shall be excluded from special warranty coverage. Warranty shall include all materials and components.

PART 2 - RODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements indicated and the design criteria specified in the Luminaire Schedule, provide one of the products specified in the Luminaire Schedule.

2.02 LUMINAIRES

A. Luminaries shall comply with UL 1598 and be designed, manufactured, listed, and labeled for installation in wet locations and for outdoor service. Make components, including nuts, bolts, rivets, springs, and similar parts, of corrosion resistant materials. Fixtures that are aimed upward shall be listed and labeled for installation in wet locations in that position.
B. Provide anodized aluminum for aluminum parts of exterior fixtures that are not specified as requiring a painted finish.
C. Lateral Light Distribution Patterns: Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
D. Metal Parts: Free of burrs and sharp corners and edges.
E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
G. 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 driver when door opens.
H. Exposed Hardware Material: Stainless steel.
I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
J. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
K. 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.
L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
M. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
    1. Where luminaire products are not indicated to be field painted and are not indicated to match the finish process and color of pole or support materials, provide the following:

a. 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) 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.

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. CCT and CRI for all luminaires.

O. Emergency Power: Provide emergency LED power pack with back box matching housing finish where indicated or, if not indicated, where required by Architect, Engineer, or Commission Authorized Representative.

2.03 LED DRIVERS

A. LED drivers shall be factory provided by the respective luminaire manufacturers, and shall be suitable for their intended use, to operate the designated LED modules listed in the Luminaire Schedule, and as specified herein, to their full light output.

B. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

C. Provide complete connection to LED-type luminaries through both integrally installed and remote electronic drivers.

D. Shall be totally enclosed within a metallic enclosure, and shall be provided with integral leads color coded per ANSI C82.11, or with poke-in style wire retaining connectors.

E. Provide identical drivers within each luminaire type.

F. Provide UL listed and labeled drivers. Provide drivers with temperature ratings appropriate to the installation.

G. Fixtures intended to be dimmed shall have dimming driver compatible with the specified dimmer controls.

H. Remote Drivers:
   1. Remove drivers are specifically not indicated in Drawings. Install remove drivers in a readily accessible, dry, indoor, concealed location in accordance with the manufacturer's written instructions.
   2. Provide ventilated metal enclosures for remove drivers furnished as loose equipment. All wiring related to remove drivers and the related LED luminaries shall be installed in conduit.
   3. Verify and comply with the remote distance limitations specified by the luminaire/driver manufacturer.

2.04 POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.
   1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
   2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. 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 stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, not less than 24-inches in diameter, and extending above and below grade as indicated in Drawings. Install with anchor bolts to match pole-base flange. Provide raceways, grounding electrodes, and other electric work relating to the pole foundations. Refer to Division 03 Section "Cast-in-Place Concrete" for concrete, reinforcement, and formwork.

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36 and hot-dip galvanized according to ASTM A 123; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Poles shall be provided with handhole, anchor bolt covers, and grounding lug.

2.05 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
   1. Shape: Round.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Handhole: Provide handhole opening, nominal 3-inches by 5-inches, at approximately 18-inches above pole base, complete with weathertight cover and securing fastener.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, and then bolted together with stainless-steel bolts. Fabricated with span and rise as indicated in Drawings.
   1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
   2. Finish: Same as pole.

F. Aluminum Finish: 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. 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.

2.06 POLE ACCESSORIES

A. Duplex Receptacle: Where indicated, provide a 120V, 20A receptacle in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
   1. Recessed, 12 inches above finished grade.
   2. Nonmetallic polycarbonate plastic or reinforced fiberglass cover, color to match pole, that when mounted results in NEMA 250, Type 3R enclosure.
   3. With cord opening.
   4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.

B. Fusing: Provide in-line fuses at handhole in each pole for each light fixture. Shall be UL listed and labeled, single pole, 600VAC, breakaway style, in-line fuse holders, designed for field

installation onto pole supported luminaires. Provide complete with fuses, sized to the specific load.

C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

2.07 EXTERIOR LIGHTING DEVICES

A. Lighting fixtures are scheduled in Drawings. Reference the Drawings for the specified and approved fixtures.

2.08 INTEGRAL PHOTOELECTRONIC CONTROLS

A. Integral, Luminaire Installed, Photocell:
   1. Where indicated, provide a photo-electronic device designed, built, and tested to provide automatic on/off control of individual luminaire, from dusk to dawn, based on ambient light level.
   2. Controls shall be UL 773A listed and fabricated to meet or exceed requirements of ANSI C136.10, with integral relay contacts rated not less than 1000VA to a ballasted load at not less than 300VAC.
   3. Provide controls with integral time delay feature to prevent false operation after momentary light flashes or light blockages.
   4. Controls shall be manufactured, or provided, by luminaire manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 LUMINAIRE INSTALLATION

A. LED Modules: Install LED modules in each luminaire in accordance with manufacturer’s instructions.

B. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials approved in writing by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

D. Where fixtures are wall-mounted and protrude from the wall surface, provide additional structural support within the wall framing to accommodate the extra moment force created by the fixture.

3.03 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
   1. Fire Hydrants and Storm Drainage Piping: 60 inches.
   2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
   3. Trees:
      a. Less than 4-inch caliper: 15 feet.
      b. Greater than 4-inch caliper: Locate outside dripline.

C. Concrete Pole Foundations:
   1. Set anchor bolts according to anchor-bolt templates and requirements furnished by pole manufacturer.
   2. Exposed concrete surfaces of bases for all light poles and light fixtures shall be free of voids and tops of bases shall be level.
   3. Remove all rough edges from exposed surfaces. Leave exposed surfaces smooth.
   4. Remove all exposed forming materials.

5. Comply with additional concrete materials, installation, and finishing requirements specified in Division 03 Section "Cast-in-Place Concrete.

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Use anchor bolts and nuts selected for the application and approved by manufacturer.
   2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
   3. Install base covers, unless otherwise indicated.
   4. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

F. Raise and set poles using web fabric slings (not chain or cable).

3.04 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Install on concrete base with top 4-inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.05 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 Division 26 Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.06 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Install a minimum of a 3/4-inch diameter by 8-foot copper grounding electrode for each pole, unless otherwise indicated, and installed as indicated in Drawings.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.07 RACEWAYS AND BOXES

A. Plastic conduit shall be used where indicated in Drawings, in unpaved areas and lawn areas. The conduit shall be Schedule 40, UL Listed, polyvinyl chloride conduit, and not less than 1-1/2 inches in diameter.

B. Galvanized rigid conduit shall be used under buildings, within five feet of entrances to buildings, in pole foundations, under paved areas and walkways, and within 18–inches, horizontally, of exterior junction boxes.

C. Provide pull line in empty conduit and duct.

D. Comply with the additional requirements of Division 26 Section “Raceways and Boxes for Electrical Systems.”

3.08 IDENTIFICATION

A. Provide vinyl tagging with panel source and circuit number on wiring at handhole in each pole and at each exterior box.

B. Identify each exterior box with 1-1/2 inch high black letters and numbers on yellow weatherproof, pressure-sensitive adhesive vinyl on the covers.

C. Identify each pole with 3-1/2 inch high black letters and numbers on yellow weatherproof, pressure sensitive adhesive vinyl placed 78-inches above grade facing the parking areas, or facing the road if the pole is at the road.

D. Comply with the additional requirements of Division 26 Section “Identification for Electrical Systems.”

3.09 CLEANING

A. Clean fixtures internally and externally after completion of installation. Use methods and materials recommended by manufacturer.

3.10 CONTRACTOR STARTUP AND REPORTING

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. Replace fixtures that show evidence of corrosion during project warranty period.
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 requirements.
E. Contractor shall train the Commission's designated maintenance personnel on the proper operation and maintenance of all products prior to Final Completion.

3.11 COMMISSIONING AND DEMONSTRATION

A. After system checkout and adjustment, the contractor shall operate the system for the review of Architect and Commission Authorized Representative, and shall make all adjustments and modifications as required by Architect and Commission Authorized Representative.

END OF SECTION

SECTION 268213
ELECTRICAL RADIANT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Electric radiant heaters.

2.02 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

3.02 SUBMITTALS

A. Product Data: Include rated capacities, specialties, controls, and accessories for each product indicated.
B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.
B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members to which heaters and suspension systems will be attached.

2. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. Conduit routing.
3. Perimeter moldings.

B. Samples for Initial Selection: For units with factory-applied color finishes.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. For Radiant Heater Finishes: 4 by 4 inches.

D. Manufacturer Seismic Qualification Certification: Submit certification that suspended radiant heaters and panels, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. 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."
   b. 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. 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. Field quality-control test reports.

C. Operation and Maintenance Data: For electric radiant heaters and panels to include in emergency, operation, and maintenance manuals.

3.02 QUALITY ASSURANCE

A. 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.

3.03 COORDINATION

A. Coordinate layout and installation of radiant heaters and panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 7 - PRODUCTS

7.01 ELECTRIC RADIANT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Basis of Design: King Electric.

B. Quartz Lamp Heating Elements: Coiled tungsten-wire heating element enclosed in clear quartz tube.

C. Element: Ni-Chrome wire embedded in Magnesium Oxide with an Incolometal sheath.

D. Metal-Sheathed Heating Elements: Nickel-chromium-wire heating element embedded in magnesium oxide powder and enclosed in metal sheath. Comply with UL 1030.

E. Standards Compliance: Listed ETL; USA and Canada. CSA 22.2 No. 46, UL 2021. ETL Listed for indoor & outdoor applications.

F. Rating: 2500, 3200, or 5000 W at 208 or 240 V.

G. Rating: 7500 W at 480 V.

H. Housing: Aluminized steel, wide symmetrical design, with black powder-coat finish. Adjustable Mounting Brackets: 0 to 45 degree.

I. Housing: Stainless steel. Adjustable Mounting Brackets: 0 to 45 degree.

J. Reflectors: Gold colored anodized aluminum.

K. Lamps: Coiled tungsten filament in sealed quartz tube. Porcelain end caps. Instantaneous heat-up & cool-down.
L. Lamp Color: Glare reducing ruby quartz.
M. Unit Controls:
1. Controller basis of design shall be: REES model No. 04960-412 Low voltage, 2.25 inch mushroom plunger with shield and weatherproof. Heavy duty tamper-proof, stainless steel with timer control, complete with power contactor and 24V remote low voltage transformer, contactor relay panel and associated class 2 control wiring in conduit to remotely switch the heater. Fully field adjustable time delay contactor relay from 5 to 60 minutes. REES Inc. (800) 495-9811. Email: sales@reesinc.com.
2. Mushroom control unit to be mounted in standard REES standard enclosure.
3. Enclosed contactor for remote thermostat.
4. Snow and ice detector with moisture sensor and integral temperature sensor.

B. Capacities and Characteristics:
1. Enclosure Length: Refer to drawings.
2. Mounting Height: Refer to drawings.
3. Heating Capacity: Refer to drawings.
4. Radiation Pattern: Refer to drawings.
5. Electrical Characteristics for Single-Point Connection:
a. Volts: Refer to drawings.
b. Phase: Refer to drawings
c. Hertz: 60
d. Full-Load Amperes: Refer to drawings.
e. Minimum Circuit Ampacity: Refer to drawings.
f. Maximum Overcurrent Protection: Refer to drawings.

PART 10 - EXECUTION

10.01 EXAMINATION

A. Examine areas to receive radiant heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Examine roughing-in for electrical connections to verify actual locations before radiant heating unit installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

10.02 INSTALLATION

A. Install radiant heating units level and plumb.
B. Suspend radiant heaters from structure.
C. Support for Radiant Heater in or on Grid-Type Suspended Ceilings: Use grid as a support element.
1. Install a minimum of four ceiling support system rods or wires for each panel. Locate not more than 6 inches from panel corners.
2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support panels 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 panel. Wire or rod shall have breaking strength of the weight of panel at a safety factor of 3.

D. Verify locations of push-button control stations with Drawings and room details before installation. Install devices 48 inches above finished floor.

10.03 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

C. Install piping adjacent to unit to allow service and maintenance.
D. Ground electric units according to Division 26 Section "Grounding and Bonding for Electrical Systems."
E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

11.02 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:
   1. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and units.
B. Remove and replace malfunctioning units and retest as specified above.
C. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

12.02 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain radiant heaters and panels. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 270000
COMMUNICATION GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This section used in conjunction with each separate specification section outline the general communications design requirements, administration topics, and installation requirements for Information and Communications Technology system (ICT).
B. Related Requirements
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the following:
   3. This specification covers all general requirements for work under this contract and the following specification sections:
      a. Section 27 05 00 - Common Work Results for Communications
      b. Section 27 08 00 – Communication Commissioning
      c. Section 27 11 00 - Communications Equipment Room Fittings
      d. Section 27 15 00 - Communications Horizontal Cabling
      e. Section 27 51 16 – Public Address System

1.02 REFERENCES:

A. Abbreviations:
   1. A/E: Architect / Engineer (designer)
   2. ACT: Acoustical Ceiling Tile
   3. BET: Building Entrance Terminal
   4. CBC: Coupled Bonding Conductor
   5. CFOI: Contractor Furnished Owner Installed
   6. E.E. Electrical Engineer
   7. EMI: Electromagnetic Interference

8. GE: Ground Equalizer
9. IDC: Insulation Displacement Contact
10. IDF: Intermediate Distribution Facility
11. I/O: Information Outlet or Work Area Information Outlet
12. LAN: Local Area Network
13. LOMMF: Laser Optimized Multimode Fiber
14. MC: Main Cross-Connect
15. MDF: Main Distribution Facility
16. NIC: Not In Contract
17. OTDR: Optical Time Domain Reflectometer
18. RCDD: Registered Communications Distribution Designer
19. TBB: Telecommunications Bonding Backbone
20. TBC: Telecommunications Bonding Conductor
21. TGB: Telecommunications Ground Bus Bar
22. TMBC: Telecommunications Main Bonding Conductor
23. TMGB: Telecommunications Main Grounding Bus Bar

1.03 REFERENCE STANDARDS & CODES:

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. The publications listed in this section form a part of this specification. The publications are referred to in the text of applicable specifications by basic designation only.

D. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest edition of each as adopted by the projects local AHJ.

E. It shall be the responsibility of the installing contractor to verify the applicable code version for all work performed with the authority having jurisdiction (AHJ).

F. Conflicts:
   1. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general, the specifications determine the nature and quality of the materials and tests, and give characteristics of performance that should be adhered to in the installation of the communications system components, the drawings establish the quantities and details of installation.
   2. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity or quality shall be estimated and installed.
   3. Clarification with the Owner and/or Owner's Representative about these items shall be made prior to ordering and installation of components.

G. All materials, installation and workmanship shall comply with the most recently approved applicable reference standards and codes addressed within each specification document.
   1. The latest edition of all listed standards as current as of the date that the work is advertised for bids
   2. The latest edition of the codes as approved and adopted by the agency/authority having jurisdiction (AHJ) as of the date that the work is advertised for bids, shall apply to the work under the Contract Documents.
   3. Codes and Regulations: (Note: Reference Division One for specific code versions governing the work in addition to the information noted below.)
      a. National Electric Code (NEC) (NFPA 70)
      b. National Electric Safety Code (NESC)
      c. National Fire Protection Association (NFPA)
      d. Life Safety Code (NFPA 101)
      e. Local Municipal Codes
   4. ANSI/IEEE 802.12 100Base-TX Ethernet

5. ANSI/IEEE 802.3ab 1000Base-T Ethernet Specification
6. ANSI/IEEE 802.3ae 10Gb/s Ethernet Specifications
7. ANSI/IEEE 802.11 Wireless Ethernet Specifications, including 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac
8. EIA-310 Cabinets, Racks, Panels and Associated Equipment Standard
9. ANSI/TIA/EIA-455-57 FOTP-57, Preparation and Examination of Optical Fiber End Face for Testing Purposes
10. ANSI/TIA-455-78 FOTP-78, Measurement Methods and Test Procedures – Attenuation
11. ANSI/TIA-455-95 FOTP-95, Absolute Optical Power Testing for Optical Fiber and Cables
12. ANSI/TIA-455-133 FOTP-133, Measurement Methods and Test Procedures – Length Measurement
13. TIA-492AAAD Detail specification for 850-nm laser-optimized, 50-um core diameter/125-um cladding diameter class 1a graded-index multimode optical fibers
14. TIA-492CAAB Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak
15. ANSI/TIA-526-7 OFSTP-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
16. ANSI/TIA-526-14 OFSTP-14, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant
17. TIA-568 Series of Standards for Commercial Building Telecommunications
18. TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces
19. TIA-598 Optical Fiber Color Coding
20. TIA-606 Administration Standard for Telecommunications Infrastructure
21. TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
22. ANSI/NECA/BICSI 607 Standard for Telecommunications Bonding and Grounding
23. TIA-758 Customer-owned Outside Plant Telecommunications Infrastructure Standard
24. TIA-942: Telecommunications Infrastructure for Data Centers
25. ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
26. ASTM E 814, “Fire Tests of Through Penetration Firestops”.
27. BICSI - Telecommunications Distribution Methods Manual
28. BICSI - Information Technology Systems Installation Manual
29. BICSI - Outside Plant Design Reference Manual
30. BICSI - Electronic Safety and Security Design Reference Manual
31. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program.
32. National Electrical Manufacturers Association (NEMA)
33. American Society for Testing Materials (ASTM)
34. Institute of Electrical and Electronic Engineers (IEEE)
35. UL Testing Bulletin
36. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.04 SCOPE OF WORK:

A. Work of this section covers a complete installation of both permanent and channel links for a structured Information Technology Infrastructure utilizing copper and fiber transmission media that includes but is not limited to the following. The Contractor shall:
   1. Comply with all Master Specifications documents and requirements for a complete and functioning project installation.
   2. It shall be the responsibility of the Division 27 contractor to coordinate with Division 26 and other trades to ensure pathways and all infrastructure are installed to comply with all specifications and contract documents.
      a. Verify conduit routing does not cause cabling to exceed specified electrical length, pulling tension, bend radius, or bend quantity.

b. Verify Bonding and grounding from MDF and IDF rooms to Grounding Electrode System provided by Division 26 contractor meets Division 27 specifications.

3. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing, labeling and testing of: fiber and copper riser and backbone cable; fiber and copper horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware, patch panels, and patch cords as required to provide a complete and functioning system.
4. Furnish all labor, materials, tools, equipment and services for the installation described herein. Provide add/deduct unit pricing for all components as part of the bid response. Assume an average cable length of 150 linear feet for comparative purposes. All requirements and specifications shall be enforced. Cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety.
5. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of the installed cable plant and equipment are maintained.
6. Verify or provide and install UL-listed firestopping systems in all communication pass-throughs, conduits and cable trays, used in ceiling, wall and floor penetrations in coordination with General Contractor.
7. Provide Submittals prior to commencement of work as outlined later in this specification.
8. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the test results and As-Built Drawings.
9. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this structured cabling system.

B. Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
   1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.
   2. Be tested for the surrounding construction and cable types involved.
   3. Have UL Systems permitting cable loads from; "Zero to 100% Visual Fill." This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.
   4. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.
   5. Be "Zero-Maintenance", zero-maintenance is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:
      a. Opening or closing of doors.
      b. Spinning rings to open or close fabric liner.
      c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
      d. Evaluation Services Report (ESR) from an accredited Nationally Recognized Third-party Laboratory certifying compliance with this definition of "Zero-Maintenance" and all relevant codes and standards.
   6. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
   7. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
   8. Cable Pathway Devices passing vertically through floors shall have equal F & T Rating.
   9. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

C. Non-rated cable pathway devices shall be used in non-fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling

where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:

1. Limit the movement of smoke and sound of wall and or floor penetrated.
2. Restore the STC Rating of the penetrated assembly.
3. Provide L Ratings of <1 CFM when empty and <2.5 CFM at all other loading up to 100 percent.
4. Accommodate cable loads from; “Zero to 100% Visual Fill.”
5. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.
6. Be “Zero-Maintenance”, zero-maintenance is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:
   a. Opening or closing of doors.
   b. Spinning rings to open or close fabric liner.
   c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
7. Furnish letter from manufacturer certifying compliance with this definition of “Zero-Maintenance”. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
8. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
9. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

D. As an alternate to using a fire-rated or non-rated cable pathway device for single low voltage cables (up to 0.27 in. (7 mm) O.D) penetrating one or two-hour, gypsum board/stud wall assemblies or non-rated assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated cable grommet may be substituted. The product shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable. The grommet product shall be capable of locking into place to secure the cable penetration within the wall assembly. The grommet shall be UL Classified and tested to the requirements of ASTM E814 (UL1479) and CAN/ULC S115.

E. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.

F. Cable pathway shall replace conduit sleeves in walls and floors, and;
   a. When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.
   b. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
   c. When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates or integrated flanges.
   d. When multiple units are ganged in walls, devices shall be anchored by means of a tested grid.

G. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

1.05 PRODUCTS AND WORK BY OTHERS (NIC) INCLUDES:

A. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of the installation process. Such items may not be

indicated in the project documents. Contractor shall coordinate with the Owner to ensure the ITS is built factoring:

1. Provision and installation of phone systems, computer hardware, and related networking software and equipment.
2. Provision and installation of UPS in communications rooms.
3. Communications grounding busbars and bonding conductors connecting to the main building electrode system.
4. Dedicated power panels, ground busbars, circuits and utility outlets.
5. Installation and finishing of plywood backboards.
6. Building mechanical ductwork, cooling/heating system, and environmental control sensors.
7. Communication pathway devices such as, but not limited to, cable tray and flex-tray in corridors, office spaces and open areas, conduits, conduit sleeves, and penetrations in walls and floors.

1.06 MEASUREMENT PROCEDURES:

A. The Contractor shall
   1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements and scale on shop drawings.
   2. Coordinate fabrication schedule with construction progress to avoid delaying the project.
   3. Where field measurements cannot be made without delaying the project, establish dimensions and coordinate with the General Contractor, and when approved, proceed with fabricating units without field measurements.
   4. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.
   5. Immediately notify the Project Team of any discrepancies before and during construction.

1.07 DELETED

1.08 DELETED

1.09 SYSTEM DESCRIPTION:

A. The objective of this project is to provide a complete ITS infrastructure installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with associated terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

1.10 SUBMITTALS:

A. The Contractor:
   1. Shall submit a minimum of six (6) weeks prior to the commencement of any work all shop drawings, product data, or samples for approval by the Owner's Representative. Such work shall be in accordance with the requirements of all specification sections related to the work.
      a. Shop drawings as required by the owner or as a minimum to include an electronic set of plan view and elevations of all work to be installed. The Contractor shall make any corrections required by the owner or the owner's representative or consultant team, file corrected copies and furnish such other copies as may be needed. The consultant's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractor has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules.
   2. Shall not perform any portion of the work that would disqualify any part or all of the ITS installation from the Manufacturer's warranty qualification.

B. The Contractor shall provide a copy of the Certified Test Data Sheet, available from the delivering distribution warehouse for either a full run or cut piece from the Master Reel of the fiber cable to be installed
   1. The Certified Test Data Sheet shall include the Master Reel number, cable description, a passing test result with details, test equipment description, date certified, and a certificate of compliance stamp, and shall be included in the O&M Manual as a component of the final deliverables submittal package.
   2. Contractor shall also include a copy of their acceptance test performed prior to installing the delivered optical fiber.
C. The Contractor shall provide the appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty. All subsequent work shall be in accordance with approved submittals.
D. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.
E. Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
F. Contractor shall submit the required Field Test Reports in the format and media specified, upon completion of testing the installed system.
G. Contractor shall deliver manufacturer's signed long-term Warranty of installed cabling system to include all components that comprise the complete cabling system. Delivery to be effective within two weeks of the time of final punch list review. Failure of any component to pass system component tests shall be promptly corrected, repaired or replaced to meet standards compliance. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.
H. Cable Commissioning Plan:
   1. The Contractor shall:
      a. Provide a complete and detailed commissioning plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber optic components and accessories prior to beginning cable testing. The following minimal items shall be submitted for review:
      b. Comply with all testing procedures and methods as listed in Specification 27 08 00 Communication Commissioning.
      c. Provide product data for test equipment
      d. Provide certifications and qualifications of all persons conducting the testing.
   2. Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once within the previous year of the testing date.
      a. Include validation, and testing. Owner will require that the telecommunications cabling system installed by the Contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and TIA standards, specifications, and vendor's warranty.
      b. Will determine the source/cause of test failure readings and correct malfunctioning component and/or workmanship within each channel or permanent link and retest to demonstrate compliance until corrected failure produces a passing result.
I. Cable Testing Reports: The Contractor shall submit cable test reports as follows:
   1. Submit certified test reports of Contractor-performed tests.
      a. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
      b. One (1) set of electronic version of test reports shall be submitted together and clearly identified with cable identification.
      c. Include software required to read test reports.

2. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination equipment. Submit data electronically on CD-ROM, listing products furnished, including:
   a. Manufacturer's name.
   b. Manufacturer's part numbers.
   c. Cable numbers.
   d. Location and riser assignments.
   e. Product Data:
3. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

J. Shop Drawings:
   1. The Contractor shall:
      a. Submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be marked with an arrow, highlighted, or underlined to indicate exact selection.
      b. Identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
      c. Submit for approval diagrams showing room layouts, rack layouts (including elevations), riser layouts, etc.
      d. Submit sample floor plan demonstrating outlet administration, clearly identifying each outlet with correct nomenclature, and legibly located on drawing.

K. Closeout Submittals (As-built Drawings):

L. As-Built drawings are to be supplied to the Architect to prepare the Record Drawings.
   1. As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents and shall include the cable numbers labeled in accordance with this document.
   2. Utilize industry recognized drafting procedures that match Architect and consultant guidelines, methodology, and symbols.
   3. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
   4. Contractor shall:
      a. Clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
      b. Maintain drawing numbering, and graphic symbol consistency as per drawings issued by Architect
   5. Provide dimensioned plan and elevation views of networking components, showing:
      a. All communications data/voice outlet locations complete with outlet/cable labeling.
      b. Cable routing paths of communications cables to identified infrastructure pathways.
      c. All rack and cabinet locations and labeling thereof.
      d. Standard or typical installation details of installations unique to Owner's requirements.

1.11 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Contractor shall supply all city, county, and state telecommunication cabling permits required by appropriate governing agency.
   2. Contractor shall be state-licensed and/or bonded as required for telecommunications/low voltage cabling systems.

B. Certifications:
   1. Contractor shall submit an up-to-date and valid certification verifying qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.

2. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to data, voice and video network systems.
3. Contracting firm shall have installed similar-sized systems in at least ten (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Certification shall include, but not be limited to, items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc
4. Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.
5. All installer personnel that will be assigned to this project shall be listed in the qualification questionnaire document. 25% shall have a minimum of 3 years' experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to Owner prior to commencement of work.
6. Contractor shall provide a registered BICSI Technician who shall act as the on-site Foreman throughout the duration of the project.
7. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.
8. Cabling installers shall be trained and certified by the connectivity/cable manufacturer for telecommunication cabling installations and maintenance of said materials. Refer also to General Conditions.

C. Products/Systems: Provide firestopping systems that comply with the following requirements:
1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
2. Firestopping products bear the classification marking of qualified testing and inspection agency.
3. Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.12 ADMINISTRATIVE REQUIREMENTS AND COORDINATION:

A. The Contractor shall:
1. Provide a specified contact person (name and contact number) for coordination to attend project meetings with the telecommunication consultant, the Owner and others.
2. Install and coordinate the telecommunications cabling work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interference in a manner accepted by the A/E. Any repairs or changes made necessary in the contract work, caused by the contractor's neglect, shall be made by the contractor at their own expense
3. Coordinate work of this section with Owner's telephone system specifications, workstations, equipment suppliers, and installers.
4. Coordinate installation work with other crafts (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc) to resolve procedures and installation placement for cable trays and cable bundle pathways. The goal of this coordination will be to establish priority pathways for critical structured cabling infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components. Damage by Contractor to the craftwork of others will be remedied at the Contractor's expense in a timely manner.
5. Exchange information and agree on details of equipment arrangements and installation interfaces. Record agreements reached in meetings and distribute record to other participants, Owner and telecommunication consultant.
6. Adjust arrangement and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN

equipment. Tasks shall be coordinated with Owner or his representative, and other trades' installation representatives.

7. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers' written instructions for installing cable and devices in modular partitions. Obtain modular furniture and power pole locations from the General Contractor. Cabling locations noted in plans along walls or in floors for modular furniture are approximate and will have to be determined by Contractor at time of installation. Field condition adjustments for installation shall be made and coordination efforts with the electrical contractor for pathway must take place early on in the project to comply with maximum 40% conduit fill ratio requirements.
8. When requested by Owner or Owner's representative, furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

B. Related Documents:
1. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, architectural plans and specifications, requirements of Division 01, electrical, mechanical, plumbing, audio visual, security and telecommunications specifications and plans apply to the telecommunications section, and shall be considered a part of this section. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.
2. Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General Contractor or Construction Manager.
3. The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner's policies.
4. When required the contractor shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.
5. Use of Subcontractors: Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.
6. The Contractor's designated project manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to ensure a quality installation.

1.13 CONTRACT ADMINISTRATION:

A. Job Field Report outline:
1. General installation progress in relation to scheduled work made by the Contractor up to that date.
2. All deficiencies noted in the cable installation to be corrected by the Contractor.

B. Pre-Installation Meetings - Contractor shall:
1. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.
   a. Agenda: This venue is to ask and clarify questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/Owner representative.
   b. Attendance: Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
   c. All individuals who will supervise installers of communication cables and equipment on-site, including project managers and lead installers, shall be required to attend the

pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of communications cables on the project.

C. Post-Installation Meetings:
   1. At the time of substantial completion, or shortly thereafter, the Contractor shall call and arrange for a post-installation meeting to present and review all submittal documents to include, but not limited to as-built drawings, test reports, warranty documentation, etc. Attendees shall be Owner staff, Owner's Representative, General Contractor, and others that the General Contractor deems appropriate.
   2. At this meeting the Contractor shall present and explain all documentation and asking for feedback on its completeness. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by Contractor and resubmitted within one week of meeting.

1.14 DELIVERY, STORAGE, AND HANDLING:

A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.
B. Contractor Shall:
   1. Be responsible for prompt material deliveries to meet contracted completion date.
   2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
   3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
   4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
   5. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.
   6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.
   7. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.
C. Owner/General Contractor shall supply a list of security requirements for Contractor to follow.

1.15 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, refer to master Architectural section.
B. For all security recommendations, refer to related Division 01.
C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Contractor will remove burrs, dirt, and construction debris. If applicable, the Contractor will repair damaged finishes, including chips, scratches, and abrasions.
D. Contractor shall provide daily a clean work environment, free from dust, trash/rubbish accumulated during and after cabling installation.
E. Telecommunication spaces shall be maintained in a dust/debris free manner at all times.
F. Contractor shall keep all liquids (drinks, sodas, etc.) off finished floors, carpets, and tiles. If any liquid or other detriment (cuts, soils, stains, etc.) damages the above finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor's expense.
G. Contractor shall coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
H. Contractor shall coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
I. Contractor shall schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

1.16 WARRANTY

A. Provide manufacturer's standard warranties as specified.

1.17 MAINTENANCE

A. Support Availability: The Contractor shall commit to make available local support for the product and system maintenance during the Warranty or Extended Warranty period.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Comply with specifications for each specific Division 27 section for acceptable products.
B. All materials shall be UL and/or ETL listed and labeled in accordance with NFPA 70 for all products where labeling service normally applies.
C. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.
D. The installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.
E. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.
F. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.
G. Expansion Capability: Unless otherwise indicated, provide spare positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in campus distribution and active workstations.
H. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.
I. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.
J. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

PART 3 - EXECUTION

3.01 INSTALLATION CONTRACTOR

A. Provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete inside and outside plant fiber and copper infrastructure system. Pay all required sales, gross receipts, and other taxes.
B. A BICSI RCDD shall be employed as the Project Manager and approve all on-site work as a recognized member of the Contractor's installation team. All installation team members must demonstrate knowledge and compliance with all BICSI, TIA, UL, and NEC methods, standards and codes.

3.02 EXAMINATION:

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
B. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

3.03 PREPARATION:

A. Contractor's RCDD Project Manager shall review, approve and stamp all shop drawings, coordination drawings As Built Drawings and submittal documents.
B. Pre-installation inspection
   1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.04 INSTALLATION:

A. General
   1. Contractor shall install work following specifications, drawings, manufacturer's instructions and approved submittal data.
   2. Allowable Cable Bend Radius and Pull Tension:
      a. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
      b. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for high performance cable installation.
B. Cable Bundles
   1. Bundling of cables is to be avoided; where bundling is necessary bundles shall be limited to no more than 24 cables.
   2. Allow cables to lay naturally in cable tray and runways whenever possible.
   3. Cables shall be neatly dressed from the point of emergence from vertical cable managers to the point of termination.
C. Pull Strings:
   1. Horizontal Cable
      a. Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract.
      b. Pull string shall have a rated average breaking strength of 200 pounds.
      c. Data and video cables can be pulled in tandem with pull strings. During pulling sessions, pull strings must move freely to prevent cable jacket/cable damage.
D. Conduit Fill:
   1. Reference manufacturer's Design Installation Guidelines manual.
   2. Comply with all applicable Listed Firestop Assembly requirements.
E. Firestop Procedures:
   1. Install and seal penetrations (conduit, sleeves, slots, chases) into or through fire-rated barriers created by or made for or on the behalf of the Contractor to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.
   2. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.
   3. Provide listed fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate firestopping procedures and materials with General Contractor. Following the pathway of others through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.
   4. Provide and install intumescent systems in floor chases in an approved fashion in all openings.
   5. Shall supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
   6. Provide manufacturer's UL Listed Assembly Sheet for rated protection for all fire barrier penetrations.
   7. Shall laminate and permanently affix adjacent to chases the following information:
      a. Manufacturer of firestop system.
      b. Date of installation/repair.

c. Listed Assembly number of system.

8. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.
9. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and local codes for fire stopping measures.
10. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.
11. Closeout documentation shall include digital photographs of all firestops related to communication cables.

F. Labeling
1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
2. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.
3. Contractor shall:
   a. Coordinate with Owner correct nomenclature for all labeling.
   b. Provide and install transparent plastic label holders, and 4-pair marked colored labels, according to the type of field as per ANSI/TIA-606-B color code designations.
   c. Use the ANSI/TIA-606 designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields.

G. Site Tests:
1. Upon completion of the communications infrastructure systems, including all pathways and bonding, the Contractor shall test the system.
   a. Cables and termination modules/connectors shall be affixed, mounted or installed to the designed/specified permanent location prior to testing. Any removal and reinstallation of any component in the circuit shall require retesting of that circuit.
   b. If the Contractor is found to have manipulated any failing test result for any reason (without written notice and approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.
2. These specifications will be strictly enforced. The Contractor shall verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing the cable type in use), and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy test data.
3. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Without contractor's prior written notice and written approval by the Owner, testing that shows some or all pairs of cable not meeting specifications, shall be replaced at Contractor's expense (including respective connectors).
4. With the Owner's written approval, the over-length cable(s) may be excluded from requirements to pass standardized tests and shall be explicitly identified.
5. Testing is still required for non-compliant cabling. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.
6. Third-Party testing of the completed cable infrastructure is an Owner option that can be implemented and completed after (1) all Contractor testing is complete and submitted, and (2) Contractor certifies that cable plant meets or exceeds test result requirements as specified in these and ANSI/TIA test standards. Third-Party testing can be implemented at the Owner's discretion by:
   a. The Owner's preference to independently confirm the submitted Contractor's standards-compliant testing results

b. Payment of all Third-Party testing shall be by the Owner if the Third-Party testing is requested for confirming Contractor‘s complete and standards-compliant test results.
c. Third-Party shall pick a randomized sample of 15% of total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.
d. Third-Party testing processes will adhere to the testing protocols delineated in this document under Section 1.10 and Specification Section 27 08 00
e. All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.
f. If Third-Party tests show a failure rate of 2% or greater of tests of all completed cabling, this shall force the retesting of the complete cable plant by the Third-Party at the Contractor’s expense.
g. All confirmed failures shall be promptly corrected and retested by Contractor and Third-Party under the same testing protocols and guidelines.
h. Payment of all Third-Party testing shall be by Contractor from Contractor’s original accepted bid if Third-Party testing is required.
i. Third-Party shall retest 100% of the total installed cable plant. Prior to testing, this party shall develop and submit a test schedule for approval by Owner.
j. All Third-Party tested cables that test as failed shall be retested by the Third Party to confirm failure.
k. All confirmed failures shall be promptly corrected the installing contractor and retested by Third-Party under the same testing protocols and guidelines.
l. Contractor will complete all work and documentation according to manufacturer guidelines to ensure manufacturer’s warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.
m. Owner reserves the right to be present during any or all testing.

3.05 CLEANING

A. Work areas will be kept in a broom clean condition throughout the duration of the installation process.
B. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
C. The Contractor will damp clean all surfaces prior to final acceptance by Owner.

3.06 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.
B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

3.07 RE-INSTALLATION

A. No additional burden to Owner regarding costs, network down-time and/or end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with Owners Representative prior to beginning the work.

3.08 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by Owners Representative and A/E team.
B. Contractor to submit all as-built drawings and test documentation required prior to acceptance by Owners Representative.

C. Issues and deficiencies identified in field reports and punch lists shall have been resolved. Final as-built drawings shall have been submitted, reviewed and found to meet the requirements of the specifications.
D. Contractor shall provide written notice of substantial completion of the telecom infrastructure. Upon receipt, the Owner's Representative will review/observe the completed installation. Once the Owner's Representative is satisfied that all work is in accordance with the Contract Documents, the Contractor will be notified in writing.
E. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements of all project specifications.

END OF SECTION

SECTION 270500
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL
1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 DESCRIPTION
A. The work covered by this Specification Section includes all labor necessary to perform and complete such construction, materials not provided by the Owners Representative, equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction.

1.03 SECTION INCLUDES
A. Bonding Conductors and Components
B. Sleeves for Pathways and Cables
C. Backbone Cable Routing
D. Horizontal Cable Routing
E. Telecom Conduits and Boxes
F. Labeling and Identification

1.04 REFERENCE STANDARDS AND CODES
A. Refer to Section 27 00 00 Communications for list of Reference Standards, Codes, and Documents. PART 1.3
    1. Specific standards may be referenced throughout this section.

1.05 SCOPE
A. Bonding of all metallic components within ITS spaces, such as, but not limited to, building steel, ladder rack, cable runway, cable tray, racks, cabinets, and conduits.
B. Testing of all bonding connections shall be conducted under the requirements of this specification.
C. This section includes the minimum requirements for communications cable pathway installations.
    1. Backbone Cable Routing
    2. Horizontal Cable Routing
    3. Products
    4. Common Requirements for Communications Installations
    5. Separation from EMI Sources
    6. Sleeve Installation for Communications Penetrations

7. Penetration of Building Surfaces
8. Cutting and Patching
9. Retrofit-Cutover

D. Provides specifications information for appropriate support in areas where cable tray or conduits are not practical.
E. Provides specifications for conduit pathways, back boxes and pull box enclosures utilized for the distribution and housing of telecommunications cabling and components:
F. Provides specifications information for identification of the various components of the telecommunications infrastructure and pathway system.
G. Bonding of all metallic components within ITS spaces, such as, but not limited to, building steel, ladder rack, cable runway, cable tray, racks, cabinets, and conduits.
H. Testing of all bonding connections shall be conducted under the requirements of this specification.

1.06 SUBMITTALS

A. Refer to Section 27 00 00 Communications. - PART 1.10

1.07 QUALITY ASSURANCE

A. Refer to Section 27 00 00 Communications. - PART 1.11

1.08 CONTRACT ADMINSTRATION

A. Refer to Section 27 00 00 Communications. – PART 1.12 – 1.13

PART 2 - PRODUCTS

2.01 ALTERNATES AND SUBSTITUTIONS

A. Refer to Section 27 00 00 Communications. PART 1.7 – 1.8

2.02 BUSBAR ASSEMBLY:

A. Manufacturer
   1. Harger Lightning & Grounding
   2. ERICO International Corporation
   3. Cooper Industries
   4. NO Substitutions Allowed
B. TMGB: 1/4-inch-thick by 4 inches high of variable length pre-drilled with TIA standard hole patterns and spacing. Number of required connections determines length of busbar.
C. TGB: 1/4-inch-thick by 2 inches high of variable length pre-drilled with TIA standard hole patterns and spacing. Number of required connections determines length of busbar.
D. When Isolated Ground is required:
   1. Rack mounted busbar: solid copper busbar 1/8-inch-thick by 2 inches wide and threaded 10-32. Varying height
E. Insulators: The busbar shall be insulated from its support.
F. Wall mounting brackets shall provide a minimum 2” separation from the wall to the back of the busbar
G. Busbars shall be UL Listed as bonding and grounding equipment.

2.03 BONDING CONDUCTORS AND COMPONENTS

A. Manufacturer
   1. USA Wire and Cable
   2. CERRO
   3. Southwire
   4. Harger
   5. Burndy
   6. Cooper Industries
B. Copper Bonding Conductors
   1. Bare or Insulated and green in color

2. Sized in accordance with TIA-607-B (2 kcmil per linear foot of conductor length)
3. Minimum size bonding conductor shall be 6 AWG
4. Maximum size bonding conductor shall be 3/0 AWG
   a. For example: A conductor 25 feet in length shall be 2 AWG (66,360 cmil)
   b. A bonding conductor 100 feet in length shall be 3/0 AWG
5. Insulation shall be rated for the environment in which installed.

C. Bolt-On Connector Lugs
1. Lugs for connecting to the TMGB and TGB shall be UL Listed two-hole, long barrel, electro tin-plated compression lugs with inspection port.
2. Compression lugs shall have two holes spaced on 5/8-inch (15.8 mm) or 1-inch (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.
3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 3/0, as stated below.
4. Antioxidant joint compound, shall be applied as required to the contact areas.
5. Lugs shall be secured to the ground bars with ¼" minimum stainless-steel hex head cap screws with stainless steel washers, lock washers and nuts.

D. Exothermic Welded Connections
1. Exothermic Welded connections shall be Ultraweld by Harger.
2. Weld types BE shall be made to the ground bars using appropriate size weld metal.
3. Weld types VA, VD, or VU shall be made to structural steel framework

E. Shield Bond Connector
1. Shield bonding assembly, with base and top members made of tin-plated tempered brass, slightly curved to exert a continuous spring force on sheath and shield after clamping, and two securing lock nuts. Designed to make a stable, low resistance electrical connection between the shield of a communications cable and a bonding conductor.

2.04 NOT USED

2.05 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: EMT with plastic bushings, or as required to meet UL Listed firestop assembly requirements.
B. Sleeves shall not extend more than six (6) inches from penetrated barrier surface.

2.06 FIRESTOPPING

A. Subject to compliance with requirements, provide products of one of the following manufacturers:
1. Hilti Firestop Systems
2. 3M, Electrical Products Division
3. Specified Technologies Inc., EZ-PATH.

B. Provide materials classified by UL to provide fire barrier equal to time rating of construction being penetrated.
C. Provide asbestos free materials that comply with applicable Codes and have been tested in accordance with UL 1479 or ASTM E 814.
D. Fire Rated Cable Pathways: Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

2.07 NOT USED

2.08 TELECOM CONDUITS AND BOXES

A. Conduit
1. UL Listed of domestic manufacture

B. Pull boxes
1. UL Listed of domestic manufacture

C. Back Boxes
1. Randle

2. Siemon
3. Hubbell

2.09 NOT USED

2.10 LABELING AND IDENTIFICATION

A. Manufacturer List:
   1. Panduit thermal transfer printer.
   2. Brady labeling system.
   3. Label-aire system.

B. Description:
   1. All labels shall be machine-manufactured. Handwritten labels shall not be accepted for final labeling.
   2. The intention of the labeling scheme is to be ANSI/TIA-606-B compliant.
   3. It is the responsibility of the contractor to acquire, understand, and utilize Owners Representative's labeling scheme for all components of the voice data communications system.
   4. It is the responsibility of the contractor to provide labels sized to show Owner's labeling scheme in readable font size while still matching the specified hardware identification dimensions.

C. Outside Plant Copper and Fiber Optic Cables:
   1. The cable sheaths shall be labeled with non-adhesive thermal transfer marker plates attached to the cables with nylon cable ties. The marker plates shall withstand harsh solvents, oils, and chemicals without over-lamination. Marker plates shall offer crisp, clear legends with superior legibility when printed on a thermal transfer desktop printer utilizing the resin ribbon designated for use and shall meet requirements for MIL-STD-202G, notice 12 Method 215J sized to fit Owner's labeling scheme in readable font size.

D. Horizontal Cable Outlet Housings and Faceplates:
   1. Cable termination connectors at each position on the outlet housing shall be labeled with laser-printed labels inserted into the outlet housing labeling window.

E. Copper Patch Panels:
   1. The patch panels shall be labeled on the front and rear top left corner with a laser-printed polyester self-laminating label sequentially identifying the patch panel.

F. Copper Patch Termination Blocks:
   1. The termination blocks shall be labeled on the front rows with the termination block designation strip colored per ANSI/TIA-606-B requirements identifying the copper cable pairs.

G. Fiber Optic Termination Panels and Housings (FDU):
   1. The panels and housings shall be labeled on the outside front and rear top left corner with a laser-printed polyester self-laminating label sequentially identifying the panel.
   2. Cable termination identifier and fiber positions inside the termination panels shall be made using the manufacturer's provided label card behind the plastic panel.

H. Outdoor Enclosures:
   1. Each wall mounted enclosure shall be identified with its individual identifier at the top right of the enclosure door. The Lettering is 1-inch tall solid two-colored injection molded letters held in an aluminum tag/letter holder. The aluminum tag/letter holder shall be attached to the enclosure with appropriate fasteners.
   2. Lettering shall be 1-inch tall white on black injection molded letters.

I. Conduit Labeling
   1. All conduits smaller than 3" shall be labeled within 12" of termination with a laser-printed polyester self-laminating label sequentially identifying the conduit and its origin and termination end (to and from).
   2. All 3" and larger conduits shall be labeled with a stainless-steel marker tag.
   3. Stainless steel marker tag shall be machine embossed with a labeling scheme approved by Owners Representative.

4. Stainless steel marker tag shall be secured with stainless steel tie wraps.
5. Marker tags shall be located at each penetration through a wall or floor, and at 50 ft.' intervals on continuous runs.

J. Outside Plant Conduits and Pull Boxes/Manholes/Vaults:
1. Each OSP conduit shall be labeled on the inside of the pull box, manhole or vault with a non-adhesive thermal transfer marker plates attached to the pull box, manhole or vault with mechanical fasteners. The marker plates shall withstand harsh solvents, oils, and chemicals without over-lamination. Marker plates shall offer crisp, clear legends with superior legibility when printed on a thermal transfer desktop printer utilizing the resin ribbon designated for use and shall meet requirements for MIL-STD-202G, Notice 12 Method 215J sized to fit Owners Representative's labeling scheme in readable font size, sequentially identifying the conduit and its origin and termination end (to and from).
2. Each pull box/manhole/vault shall be identified on the cover plate/lid sequentially identifying the pull box/manhole/vault.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

A. Bonding to Structural Steel of a Building
1. All bonding conductors and connectors for bonding the metal frame of a building shall be listed for the purpose intended by a NRTL.
2. In buildings where, metal frames (structural steel) are effectively grounded, each T(M)GB shall be bonded to the structural steel within the room using a properly sized bonding conductor and connection method.
3. Connections to the structural steel frame shall be made by exothermic welding. The area of contact on the steel frame shall be cleaned to bare metal removing all paint and mill scale. The contact area shall be protected from corrosion using Harger series HAAJC antioxidant joint compound.
4. Where the structural steel is external to the room and readily accessible the structural steel shall be bonded to the T(M)GB with a properly sized bonding conductor.
5. Steel bars of a reinforced concrete building are not required to be bonded to the T(M)GB.

B. Conduits and Cable Trays
1. All metal conduits and raceways for telecommunications cabling located within the telecommunications space as the busbar shall be bonded to the busbar.
2. Metal cable trays shall be bonded to the busbar.

C. Shield Bond Connector Installation
1. The Contractor shall provide a shield bond connector to the shield of each fiber optic and copper riser cable in order to make a stable, low-resistance connections between the shield and a bonding conductor.
2. The bonding jumper at the shield bond connector end shall have a single hole standard barrel lug with a 6 AWG conductor. The other end of the bonding jumper shall be a 2-hole long barrel compression for bonding at the T(M)GB.

D. Testing
1. The Telecommunications Bonding and Grounding System shall be tested with an Earth Ground Resistance Tester using the Two Point Test Method.
2. The following shall be required to test the bonding and grounding.
a. An Earth Ground Resistance Tester with the attachments.
b. All testing should be done with the entire building in operation. Nothing needs to be shut down to test the bonding and grounding with this tester.
c. If the resistance value is less than 0.1 Ohm between the two test points the bonding is adequate.

3. Tests to be conducted:
    a. The installer / technician conducting these tests must be certified
    b. Test between the TMGB and the service equipment (power) ground.
    c. Test between the TMGB and each TGB in the system.
    d. Test between the TGB and:
        1. Telecommunication conduit
        2. Electronic equipment
4. Tests shall be conducted with the systems in operation.
5. Tests shall be recorded and submitted to the Owner's Representative.

3.03 BACKBONE CABLE ROUTING

A. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all telecommunications rooms, such that no drilling of additional sleeves/slots are necessary.
B. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.
C. Backbone pathways shall be installed or selected such that the minimum bend radius and pulling tension of backbone cables is kept within cable manufacturer specifications both during and after installation.

3.04 HORIZONTAL CABLE ROUTING

A. All horizontal cables shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
B. Cable Bundles
    1. Bundling of cables is to be avoided; where bundling is necessary bundles shall be limited to no more than 24 cables.
    2. Allow cables to lay naturally in cable tray and runways whenever possible.
    3. Cables shall be neatly dressed from the point of emergence from vertical cable managers to the point of termination.
C. Consolidation points shall not be used.
D. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
E. In ACT type ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5 m (5 ft) apart.
F. For voice or data applications, 4-pair copper balanced twisted-pair cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet. The Owner prior to installation of the cabling shall approve all cable routes.
G. The Contractor shall observe the bend radius and pulling strength requirements of the 4 pair copper balanced twisted-pair optic cable during handling and installation.
H. Each run of 4-pair copper twisted-pair cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.
I. In an ACT type ceiling environment, a minimum of 75 mm (3 in) shall be observed between the cable supports and the ACT.
J. Continuous conduit runs installed by the contractor should not exceed 30.5 m (100 ft) or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.
K. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
L. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables to be altered. Under no circumstances should cables in the horizontal pathway be bundled. This is to minimize "alien" cross talk.
M. Maximum conduit pathway capacity shall not exceed a 40 percent fill. However, perimeter and furniture fill ratio is limited to 60% fill for moves, adds, and changes.

1. Horizontal distribution cables shall not be exposed in the work area or other locations with public access.

3.05 SEPARATION FROM EMI SOURCES:

A. Comply with TIAEIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
B. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   3. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
C. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   3. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
D. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   1. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   3. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
E. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or higher: A minimum of 48 inches.
F. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.06 NOT USED

3.07 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate framed wall assemblies, concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Each pipe sleeve, horizontal or vertical, shall have a plastic type “end-bushing” on both ends to protect cables from abrasion when pulled through sleeves. The “end-bushing” shall be installed prior to install cables through sleeve.
E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
F. Cut sleeves to length for mounting flush with both surfaces of walls with respect to plastic “end-bushings”. The plastic “end-bushing” shall be plenum rated if applied in plenum space.
G. Extend sleeves installed in floors 2 inches above finished floor level with respect to plastic “end-bushings”. The plastic “end-bushing” shall be plenum rated if applied in plenum space.
H. Size pipe sleeves to provide ¼-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
I. Seal space outside of sleeves with grout for penetrations of concrete and masonry. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable

penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Weather seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.08 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

C. Provide sleeves for new conduit and cable penetrations of building construction.
   1. Openings to accept sleeves in new building construction will be formed in building construction by the Contractor for General Construction work. Openings to accept sleeves in existing building construction shall be provided under this division of the Specifications. Refer to, CUTTING AND PATCHING in this Section.
   2. Use galvanized rigid conduit sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks.
   3. Use only fire-rated listed assemblies for the type of sleeve being installed through CMU walls or gypsum walls for communications penetrations. Sleeve type shall be galvanized rigid conduit.

D. Where conduits are installed before building construction being penetrated, install sleeves loose around conduits. Split, fit, and weld steel sleeves over existing conduits, with respect to anything flammable in the surrounding environment.

E. Secure sleeves firmly in place using filling and patching materials (grout) that match with surrounding construction.

F. In floor penetrations, extend sleeve 4 inches above finished floor unless noted otherwise. In wall penetrations, cut sleeves flush with wall surface and use metal escutcheon plates in finished interior areas.

G. Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the Work with installation of firestopping, conduit insulation, and waterproofing as applicable.

H. The Contractor shall be fully responsible for final and correct location of sleeves. Sleeves which are omitted or incorrectly located in existing building construction, shall be corrected and provided by the Communications Contractor, at no additional costs to the Owner.

3.09 PENETRATION OF BUILDING SURFACES

A. Above Grade Level or Non-waterproof Areas
   1. Seal each annular space between conduits or cable and building surfaces. Pack space with oakum, other rope packing, or backer rod materials and cover with fire-resistant sealant or other protection materials.
   2. Provide sleeves as specified in article, sleeve-seal installation in this section for conduit and cable penetrations. Seal each space between conduit or cable and sleeve. Sealing shall be as specified in above paragraph.

B. Waterproof areas (above and below grade)
   1. In new and existing construction for penetrations through concrete below grade, ground water level, or in other waterproof areas, provide through-wall and floor seals having galvanized fittings, sealing assemblies, and sleeves as specified.
   2. In existing construction when core bore drilled openings are used for conduit penetrations below grade, ground water level, or in other waterproof areas, provide sealing.

C. Fire-resistant areas
   1. Provide through-penetration firestop systems for penetrations through fire-rated walls, floors, and other partitions of building construction. Comply with requirements in division 07 section "penetration firestopping".

2. In walls or partitions with 2-hour or less fire ratings, provide only metallic outlet or device boxes installed per UL fire resistance director, NEC, and other national building code requirements.

3.10 CUTTING AND PATCHING

A. Provide openings, cutting, coring, and patching of openings in existing building construction as required. Patching includes openings and voids left in existing construction as a result of demolition.
B. The Work shall include necessary assemblies and materials to maintain required fire ratings.
C. Perform cutting as to not impair structural stability of building construction and systems. Do not drill holes or weld attachments to beams and other structural members without prior written approval from the Owner's Representative. Contact the Engineer-of-Record for guidance.
D. The Work shall be done by a craftsperson skilled in the particular trades affected.
E. Patching materials shall match existing materials in type and quality. Patching shall be done in a manner to match appearance of adjacent surfaces.

3.11 RETROFIT-CUTOVER

A. Furnish equipment, materials, labor and services, and perform operations required to retrofit/cutover existing cabling systems. Removals shown are general indications and may not indicate full extent of removals which may be required to complete Work.
B. Furnish equipment, materials, labor and services, and performing operations required to enable continued functioning of existing system until cutover to new system.
C. Remove wiring, punch blocks, cabinets, outlets, raceways, and equipment not required for new system.
    1. Abandon flush mounted device and junction boxes and cover with blank plate to match the current room decor.
    2. Remove surface telecommunications outlets and pathways unless said removal will damage the existing finish on surfaces, or physically damage the structure.
    3. Remove wiring from abandoned conduits and raceways from the work area outlet back to the corresponding termination point in the telecommunication room. Place a trailer string in vacated conduits and raceways.
    4. Remove labeling at both ends for abandoned cables/wiring.
    5. The collected abandoned cables/wiring shall be collected and removed from site by contractor.
D. Perform the work in neat and workmanlike manner in accordance with the applicable codes, standards and AHJ.
E. Removal and replacement of existing ceilings:
    1. Carefully remove existing ceilings as required to perform the work. Store removed tiles in an area designated by the owner. Modify and augment existing suspension systems as necessary. Restore ceiling systems to their original finish.
    2. Repair any damage to ceilings due to modifications, removal, and replacement of same. Replace damaged ceiling tiles, including tiles with holes or openings left as a result of demolition, with materials of like kind.
F. Existing equipment or material shall not be reused without specific approval of the Owner's Representative except as noted below:
    1. Existing cable terminal housings may be reused if in good condition.
G. Equipment and materials to be removed and not desired by the Owner shall be removed from site promptly.
H. Equipment and material to be removed and that is desired by the Owner shall be moved to an on-site storage location as directed by the Owner.

3.12 FIRESTOPPING

A. Performance Requirements
    1. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.

2. Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
3. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
4. Openings for cable trays shall be sealed using re-enterable firestopping pillows.

B. Quality Assurance
1. Products/systems: provide firestopping systems that comply with the following requirements:
2. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
3. Firestopping products bear the classification marking of qualified testing and inspection agency.
4. Installer qualifications: experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

C. Project Conditions
1. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
3. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
4. Do not use materials that contain flammable solvents.
5. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
6. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
7. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

3.13 NOT USED

3.14 TELECOM CONDUITS AND BOXES

A. Pull Boxes:
1. Install Pull boxes in easily accessible locations.
2. Install Horizontal cabling boxes minimum 6” above suspended ceilings.
3. A pull box should not be used in lieu of a bend.
4. Conduits that enter the pull box from opposite ends with each other should be aligned.
5. For direct access to a box located above inaccessible ceilings provide a suitable, marked, hinged access panel (or equivalent) in the ceiling. This access panel can also serve as the cover for the box.
6. Pull box sizing table:

Conduit Trade Size (in.)	Pull Box Width (in.)	Pull Box Length (in.)	Pull Box Depth (in.)	Pull Box Width Increase for Additional Conduit (in.)
1	4	16	3	2
1 1/4	6	20	3	3
1 1/2	8	27	4	4
2	8	36	4	5
2 1/2	10	42	5	6

3	12	48	5	6
3 1/2	12	54	6	6
4	15	60	8	8

B. Back Boxes:
   1. Provide 5” H X 5” W X 2-7/8” D outlet back boxes with integrated cable management at all telecom outlet locations shown on drawings.
   2. Provide (1) 1-1/4” conduit from back box to telecom cable tray, except as otherwise noted.
   3. Provide single gang plaster/mud ring on all communications outlet back boxes, unless indicated otherwise in the contract drawings.
   4. Provide bonding to cable pathways.

C. Conduit Support and Bracing:
   1. Coordinate layout and installation of conduits and pull boxes with other trade conditions to ensure adequate clearances, access and cable management.
   2. Provide seismic support and bracing for all conduits and pull boxes installed under work of this project per the project’s structural requirements. Any proposed reinforcement is the responsibility of the Contractor.
   3. Coordinate seismic design with architectural, structural, mechanical, electrical, plumbing, fire protection, and other trades.
   4. Structural braces and/or reinforcements are to be attached directly to structural framework and secondary structural members; do not attach braces and/or reinforcements to elements other than structural framework and secondary structural members.
   5. Install and provide support for conduits and pull boxes in accordance with the latest edition of the NEC, as well as all state and local codes and requirements. Coordinate installation and location with existing conditions.
   6. Install conduits above ceilings at height to provide access to pull boxes and cable access to where conduits terminate to meet up with cable trays. Install conduits and pull boxes level and square and at proper elevations. Ensure adequate clearances, access and cable management.
   7. Supporting devices: U channel trapeze assemblies, 3/8” threaded rods, clamps, conduit straps, C-clamps and retainers.
   8. Fasteners: Carbon steel expansion anchors with minimum 3” embed into concrete slab for pull box U-channel support attachment. The anchors must be tested and approved under dual load conditions.
   9. U-channel systems: 16 gauge steel channels. Provide fittings and accessories that match with the U-channel of the same manufacturer.
   10. Use fittings and support devices compatible with conduits and pull boxes and suitable for use and location.
   11. Install individual and multiple trapeze hangers and riser clamps as necessary to support the conduits. Provide U-bolts, clamp attachments and other necessary hardware for hanger assemblies and for securing hanger rods and conduits. Space supports for conduits on maximum 10-foot centers.
   12. Provide and install expansion or deflection fittings for conduits runs at all instances of seismic or expansion joints to allow for movement in any direction.

D. Conduit Routing, Bends and Radius Guidelines:
   1. If the conduit has an internal diameter of 2 inches or less the bend radius must be at least 6 times the internal conduit diameter.
   2. If the conduit has an internal diameter of more than 2 inches the bend radius must be at least 10 times the internal conduit diameter.
   3. Conduit bends should be smooth, even, and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity during or after installation.
   4. If a conduit run requires more than two 90 degree bends then provide a pull box between sections with two bends or less.

5. If a conduit run requires a reverse bend (between 100 degrees and 180 degrees) then insert a pull point or pull box at each bend having an angle from 100 degrees to 180 degrees.
6. Consider an offset as equivalent to a 90 degree bend.
7. Achieve the best direct route with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
8. Contain no continuous sections longer than 100 ft.
9. For runs that total more than 100 ft. in length, pull points or pull boxes should be inserted so that no segment between points/boxes exceeds the 100 ft. limit.
10. Withstand the environment to which they will be exposed.
11. Conduits shall not be routed through areas in which flammable material may be stored or over or adjacent to boilers, incinerators, hot-water lines and steam lines.
12. Maintain 6” separation from parallel runs of steam, hot water pipes or mechanical ductwork so as not to affect cable performance.

E. Conduit Terminations:
1. Join conduits with fittings designed and approved for the purpose. Make the joints tight without protrusions that may damage cable inside the conduits.
2. Where conduits are terminated with locknuts and bushings align the conduit to enter squarely and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box.
3. Ream all conduit ends and fit them with an insulated bushing, connector, or coupling to eliminate sharp edges that can damage cables during installation or service.
4. Conduits that enter a telecom room should terminate near the corners to allow for proper cable racking.
5. Terminate conduits that protrude through the structural floor 3 inches above the surface.
6. Maintain the integrity of all fire stop barriers for all floor and wall penetrations.
7. Provide bonding for conduits and pull boxes as indicated by the NEC, ANSI/NECA/BICSI 607-2011, and as instructed by manufacturer.
8. Conduits shall be clearly labeled at both ends designating the opposite locations(s) served. The numbering scheme shall be room number plus a suffix to guarantee uniqueness, e.g., 143-1. Labeling must be machine generated.

F. Conduit Protection:
1. Remove burrs, dirt and construction debris from conduits and pull boxes.
2. Conduits should be left capped for protection.
3. Provide final protection and maintain conditions in a manner acceptable to the Owner’s Representative to ensure that coatings, finishes and pull boxes are without damage or deterioration at completion. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.

3.15 NOT USED

3.16 LABELING

A. The labeling scheme is intended to comply with ANSI/TIA-606-B standard for labeling and administration of a cable plant. It is the responsibility of the contractor to acquire, understand, and utilize the Owner labeling scheme for all component of the voice data communications systems including, but not limited to:
1. Indoor Horizontal copper and fiber optic cables (Identify at both ends within 6-inches of termination)
2. Indoor copper and fiber optic backbone cables shall be identified at both ends within 12-inches of the point that the cable enters or exits termination panels/blocks, pull boxes, wall and floor sleeves.
3. Outside plant copper and fiber optic backbone cables shall be identified at both ends within 12-inches of the point that the cable enters or exits termination panels/blocks, pull boxes, manholes, vaults and pedestals.
4. Workstation outlets, faceplates and individual outlet connectors.

5. Termination panels and blocks.
6. Racks, cabinets, and equipment enclosures. (front and rear)
7. Indoor and OSP conduit pathways, pull boxes, manholes, and vaults.
8. Bonding conductors and busbars.
9. Label each component with a specified label at an unobstructed view location and where it is accessible for administration.

3.17 RE-INSTALLATION

A. Refer to Section 27 00 00 Communications. - PART 3.7

3.18 CLOSEOUT ACTIVITIES

A. Refer to Section 27 00 00 Communications. - PART 3.8

END OF SECTION

SECTION 270800
COMMUNICATION COMMISSIONING

PART 4 - GENERAL

4.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

4.02 DESCRIPTION

A. The work covered by this Specification Section includes all labor necessary to perform and complete such construction, materials not provided by the Owners Representative, equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction.

4.03 SECTION INCLUDES

A. Copper cable test device
B. Optical fiber test device
C. Coaxial cable test device

4.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 Communications for list of Reference Standards, Codes, and Documents. PART 1.3
   1. Specific standards may be referenced throughout this section.

4.05 SCOPE

A. Provides specifications for a certification tester used for end to end testing, certification, and documentation of all test results to confirm the installed connectivity system complies with industry standards and specific category and performance ratings.

4.06 SUBMITTALS

A. Refer to Section 27 00 00 Communications. - PART 1.10
   1. Electronic Reports: Submit in CD format. Include necessary software required to view test results. Accompany electronic reports by Certificate signed by authorized representative of Contractor warranting truth and accuracy of electronic report. Certificate: Reference traceable circuit numbers that match electronic record. Contain following information on each row of report: Circuit ID, test specification used, length, date of test, and pass/fail results.

4.07 QUALITY ASSURANCE

A. Refer to Section 27 00 00 Communications. - PART 1.11

4.08 CONTRACT ADMINISTRATION

A. Refer to Section 27 00 00 Communications. – PART 1.12 – 1.13

PART 5 - PRODUCTS

5.01 ALTERNATES AND SUBSTITUTIONS

A. Refer to Section 27 00 00 Communications. PART 1.7 – 1.8
   1. No Substitution without pre-approval.

5.02 COPPER CABLE TESTER

A. Manufacturer List:
   1. Fluke
   2. Agilent
B. Description:
   1. Must meet or exceed TIA Level IV compliant network cable-testing device certification by an independent laboratory, such as Intertek, for verification of high performance cables.
   2. Copper test equipment must be capable of certifying Category-3, Category-5e, Category-6 and Category-6A UTP and F/UTP links or channels independent of termination hardware configuration (8P8C port or 110-style) for each level of performance.
   3. Provide full 2-way Autotest of Category-3, 5E, 6 and 6A twisted pair links.
   4. All test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
C. Accessory Products:
   1. Interface Adapters
   2. Category/Class E permanent link adapters for TIA unshielded and shielded cables.
   3. DTX ten (10) Gigabit Kit

5.03 OPTICAL FIBER TESTER

A. Manufacturer List:
   1. Fluke
   2. Agilent
B. Product Options:
   1. Select analyzer to comprehensively certify each optical fiber connection and record results verifying compliance with TIA/EIA performance standards and manufacturer specifications.
   2. Tier 2 OptiFiber
C. Description:
   1. The optical fiber source shall permit full end to end testing of Multimode, Single-mode and LOMMF optical fiber cabling fully compliant with industry standards and manufacturer recommendations.
   2. Available source types and wavelengths shall be as follows:
      a. Multimode - 850nm LED and 1300nm LED.
      b. Single-mode – 1310nm FP Laser and 1550nm FP Laser.
      c. LOMMF – 850nm VCSEL and 1310nm FP Laser.
   3. The built in power meter shall be calibrated to read 850, 1310 and 1550nm wavelengths.
   4. All test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
D. Accessory Products:
   1. Interface Adapters
      a. Fiber Modules including Multimode, Single-mode and LOMMF adapters.
      b. Optical Fiber Mandrels.

5.04 COAXIAL CABLE TESTER

A. Manufacturer List:
   1. Fluke
   2. Agilent
B. Product Options
   1. Select analyzer to comprehensively Autotest each connection and record results verifying compliance with industry standards and manufacturer specifications.
      a. DTX or Equal Digital Cable Analyzer
C. Description
   1. The tester's Autotest function shall test and record cable resistance, length, impedance, insertion loss and propagation delay. Additionally, the tester shall provide a TDR function that provides extended troubleshooting capabilities.
   2. All test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
D. Accessory Products:
   1. Interface Adapters
      a. DTX-Coax Interface Adapters

PART 6 - EXECUTION

6.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.
B. Verify telecommunications cabling is installed and supported, terminated, mounted in an appropriate housing or terminated on the applicable component and labeled prior to certification testing and documentation.
C. Verify certification tester universal interface adapters and manufacturer patch cords that enable permanent link verification are in new condition not indicating any twisting or kinking resulting from incorrect storage of the tester interface adapters.
D. Optical fiber patch cords shall be inspected to ensure connector surfaces are clean and free of defects that may affect testing results.
E. Refer to Section 01 91 00 - General Commissioning Requirements.
F. Refer to Section 27 00 00 – 3.4 and 3.6 for additional requirements.

6.02 TEST INSTRUMENT SUBMITTALS

A. All copper & fiber optic test instruments used on the site shall be capable of storing test data files and downloading these test results as data files. The unique cable/strand number previously approved as per Specification 27 05 53 shall be used as the record identifier for each test.
B. Submit a certificate verifying the model number, serial number, manufacturer, last date of calibration/certification for each test instrument used on the site prior to any testing.

6.03 TEST AND EVALUATION REPORTS:

A. Prior to commencement of full system testing a test sample shall be submitted to Owner's Representative in order to verify correct testing procedures.
   1. Sample test reports shall include:
      a. Copper tests for one (1) complete 48 port patch panel
      b. Optical Fiber tests for 24 consecutive MMF strands
      c. Optical Fiber tests for 24 consecutive SMF strands
   2. These reports shall be reviewed and accepted by Owner's Representative prior to any additional testing.
   3. Should the contractor fail to provide sample test reports prior to full system testing and issues are found with submitted test reports, full retesting of installed cable plant shall be required at the contractors expense.

B. A complete set of test results verifying the installed link performance parameter results for all cable types shall be presented to the Owner's Representative at least two (2) weeks before the placement of any active electronics in technology rooms and/or spaces.
C. Verification and test results in electronic format saved directly from the testing device software application. Results must be neatly presented and organized according to floor and cable type; OSP, ISP, Category-6A, Category-3, and optical fiber cables (backbone and workstation fiber) must be divided into separate sections for each floor. Electronic results shall be presented in the testing device's native file type with a copy of the electronic software used to generate the test results when requested.

6.04 OPTICAL FIBER CABLE TESTING

A. Fiber Testing: Perform on fibers in completed end to end system. Splices not allowed unless clearly defined and pre-approved by Owner's Representative.
   1. Testing: Bi-directional end to end power meter test, TIA/EIA 455-53A.
   2. Test horizontal multimode fiber at both 850nm and 1300nm, TIA-526-14-A OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant - Method B, (1 Jumper Reference)
      a. The following loss limits shall apply to Horizontal segments regardless of actual link configuration:
         1. Permanent Link 2.0 dB
         2. Permanent Link w/ CP 2.8 dB
         3. Permanent Link w/MUTOA 2.0 dB
         4. Centralized Fiber 3.3 dB
         5. Centralized Fiber w/ CP 3.3 dB
   3. Test backbone multimode fiber at both 850nm and 1300nm, TIA-526-14-A OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant - Method A, (2 Jumper Reference)
   4. Test all single-mode fiber at both 1310 nm and 1550 nm, TIA/EIA 526-7 OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant - Method A.2 (2 Jumper Reference)
B. Pre-installation Cable Testing: Test fiber optic cable prior to installation of cable.
   1. Contractor shall be solely responsible for replacement of cable if found defective at later date.
C. Loss Budget – Backbone Fiber Links: Maximum loss of:
   1. (Allowable cable loss per km)*(km's of fiber in link) + (.5dB)*(number of connector pairs) + (.15dB)*(number of splices) = maximum allowable loss
   2. Splice Losses from Fusion Splice Pigtail Connectors and Fusion Splice-On Connectors shall not be counted in the Loss Budget. Only the Connector Loss shall be counted for Loss Budget.
   3. All test reports exhibiting a Headroom Margin of 0.25 dB or less shall be considered as not meeting requirements of this specification.
   4. Bring links not meeting requirements of this specification into compliance, at no charge to Owner.
D. Documentation: Provide native electronic test reports to point of contact, include required software to view electronic results.

6.05 COPPER AND COAXIAL CABLE TESTING

A. Certification test 100% of the installed cabling plant including all backbone and horizontal four (4) pair copper, multi-pair UTP and coaxial connections.
B. Follow manufacturers' instructions and recommended industry standards and guidelines to complete all TIA/EIA testing procedures to verify performance levels.
C. Follow manufacturer requirements for self-calibration procedures.
D. Update tester software to show specific project information including but not limited to:
   1. Date and time of testing
   2. Project name

3. Field technicians name
4. Cable identification number
5. Cable manufacturer, type and part number

E. REPAIR
1. Any connections failing to meet referenced standards or more stringent performance requirements stated above, must be removed and replaced with connections that prove, in additional testing, to meet or exceed the performance standards set forth.
2. Refer to Section 01 91 00 - General Commissioning Requirements.

6.06 RE-INSTALLATION

A. Refer to Section 27 00 00 Communications. - PART 3.7

6.07 CLOSEOUT ACTIVITIES

A. Refer to Section 27 00 00 Communications. - PART 3.8

END OF SECTION

SECTION 271500
COMMUNICATION HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 DESCRIPTION

A. The work covered by this Specification Section includes all labor necessary to perform and complete such construction, materials not provided by the Owners Representative, equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction.

1.03 SECTION INCLUDES

A. Category 6 Four-Pair UTP Cabling
B. Horizontal Single-mode Optical Fiber Cable
C. Horizontal LOMMF Optical Fiber Cable
D. RG-6 Coaxial Cable
E. Copper UTP Connectors
F. Indoor Multimode Optical Fiber Connectors (Field Termination Type)
G. Outdoor Multimode Optical Fiber Connectors (Field Termination Type)
H. Single Mode Optical Fiber Pigtail Connector Assemblies
I. Outlet Housing Components (faceplates etc.)
J. Optical Fiber Couplers at workstation outlet locations
K. RG-11 Connectors
L. RG-6 Connectors

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 Communications for list of Reference Standards, Codes, and Documents. PART 1.3
1. Specific standards may be referenced throughout this section.

1.05 SCOPE

A. Provides specifications for horizontal workstation cabling to distribute signals between telecommunications distribution spaces and various workstation outlet locations.
B. Provides specifications for horizontal workstation cable termination components and outlet housing component. Includes wall-mount, floor-mount, and ceiling-mount components to support the various workstation outlets throughout the cabling plant.

1.06 SUBMITTALS
A. Refer to Section 27 00 00 Communications. - PART 1.10

1.07 QUALITY ASSURANCE
A. Refer to Section 27 00 00 Communications. - PART 1.11

1.08 CONTRACT ADMINISTRATION
A. Refer to Section 27 00 00 Communications. – PART 1.12 – 1.13

PART 2 - PRODUCTS
2.01 ALTERNATES AND SUBSTITUTIONS
A. Refer to Section 27 00 00 Communications. PART 1.7 – 1.8
1. No Substitution without pre-approval.

2.02 FOUR PAIR UTP CABLING
A. Manufacturer List:
1. Superior Essex Category-6 UTP
2. Berk-Tek Category-6 UTP
3. Panduit Category-6 UTP
B. Description
1. All augmented Category-6 performance four (4) pair UTP cable shall consist of eight (8) twenty-three (23) gauge, or twenty-two (22) gauge, thermoplastic insulated solid twisted conductors that utilize the industry standard color code designations and provided with overall aluminum foil shield and longitudinal drain wire.
2. The performance criteria for four (4) pair UTP cable shall be meet or exceed specific ANSI/TIA-568 standards for Category-6A cable rating and shall show stable performance with documented electrical characterization out to 500 MHz.
3. Cables shall be rated per the installation environment as required by the local AHJ and building codes.
4. Select an appropriate cable construction, including external jacket properties, when installing cables in aerial, outdoor, underground and corrosive environments.
C. Accessory Products
1. Provide any accessory products related to the UTP copper 4-pair cabling required to provide a complete and functional infrastructure system.

2.03 HORIZONTAL SINGLE-MODE OPTICAL FIBER CABLE
A. Manufacturer List:
1. Superior Essex
2. Berk-Tek
3. Panduit
B. Description:
1. All single-mode optical fiber cable shall be capable of Ethernet signal transmission at 10 Gb/s up to 10,000 meters in the 1310nm operating window. Maximum attenuation for a single-mode indoor/outdoor cable shall be no greater than 0.5 dB per kilometer using 1310nm and 1550nm wavelengths.
2. Each optical fiber strand shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification and all ANSI/TIA-568 performance parameters.

3. All optical fibers inside each individual cable shall be provided in counts indicated in the T-series drawings and usable to the fullest capacity specified by the manufacturer and meet required specifications at all times.
4. Indoor horizontal single-mode optical fiber cables shall be:
   a. Individual jacketed, tight buffered fiber type.
   b. The individual fibers are grouped in jacketed subunits color coded per ANSI/TIA-598.
   c. Have integrated dielectric central and strength members.
   d. Flame retardant outer jacket in a yellow color to designate the type of optical fiber.
5. The optical fiber cables shall be rated per the installation environment as required by the local Authority Having Jurisdiction and/or National Fire Codes. Select an appropriate cable construction, including external jacket properties, when installing optical fiber cables in aerial, outdoor, underground and corrosive environments.
6. All SMF shall meet or exceed TIA compliant network cable-testing device certification by an independent laboratory, such as ETL, for verification of high speed, ANSI/TIA-568 compliant performance.

C. Accessory Products:
1. Provide any accessory products related to the optical fiber cabling required to provide a complete and functional infrastructure system.

2.04 HORIZONTAL LASER-OPTIMIZED MULTIMODE OPTICAL FIBER CABLE (OM4)

A. Manufacturer List:
1. Superior Essex
2. Berk-Tek
3. Panduit

B. Description:
1. All LOMMF cables shall be capable of Ethernet signal transmission at 10 Gb/s up to 550 meters at 4700 MHz/km effective modal bandwidth, while allowing the use of low-cost, 850 nm vertical cavity surface emitting laser (VCSEL). Maximum attenuation for a LOMMF cable shall be no greater than 3.0dB per kilometer using 850nm and 1.0dB per kilometer using 1300nm wavelengths respectively. (OM4)
2. Each optical fiber strand shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification and all ANSI/TIA-568 performance parameters.
3. All optical fibers inside each individual cable shall be provided in counts indicated in the T-series drawings and be usable to the fullest capacity specified by the manufacturer and meet required specifications at all times.
4. Indoor horizontal 50 μm multi-mode optical fiber cable shall be:
   a. Individual jacketed, tight buffered fiber type.
   b. The individual fibers are grouped in jacketed subunits color coded per ANSI/TIA-598.
   c. Have integrated dielectric central and strength members.
   d. Flame retardant outer jacket in an industry standard aqua color to designate the type of optical fiber.
5. The optical fiber cables shall be rated per the installation environment as required by the local Authority Having Jurisdiction and/or National Fire Codes. Select an appropriate cable construction, including external jacket properties, when installing optical fiber cables in aerial, outdoor, underground and corrosive environments.

C. Accessory Products:
1. Provide any accessory products related to the optical fiber cabling required to provide a complete and functional infrastructure system.

2.05 RG-6 COAXIAL CABLE

A. Manufacturer List:
1. Belden Coaxial Cable
2. Superior Essex Coaxial Cable
3. Commscope Coaxial Cable

B. Description:
   1. RG-6 coaxial cable shall exhibit a nominal impedance of seventy-five (75) Ohms.
   2. Typical attenuation for RG-6 coaxial cables shall be 5.5dB (± 0.5 db) per 100 feet (100') of cable at a seven hundred and fifty (750) megahertz wavelength. All coaxial cables shall be swept-tested to 2.2 GHz.
   3. The coaxial center conductor shall be solid gauge that is encased by a foam dielectric used to meet or exceed electrical and fire-safety and code compliance and performance.
   4. RG-6 coaxial cable shall exhibit stable performance in a building environment, as well as in an exterior exposed environment, and shall have a quad shield design.
   5. It is the responsibility of the contractor to bid, purchase, install, and verify the rating of the ISP and OSP cable for the specific construction conditions.
   6. Select an appropriate cable construction, including external jacket properties, when installing cables in aerial, outdoor, underground and corrosive environments.

C. Accessory Products
   1. Provide any accessory products related to the coaxial horizontal cabling required to provide a complete and functional infrastructure system.

2.06 COPPER UTP CONNECTORS

A. Manufacturer List:
   1. Ortronics Category-6 UTP Connectors
   2. Leviton Category-6 UTP Connectors
   3. Belden Category-6 UTP Connectors

B. Description:
   1. All UTP connectors shall be rated to perform at or above current ANSI/TIA-568 performance parameters of the UTP cabling it is terminating within the communications system.
   2. All UTP connectors shall have an eight (8) Position, eight (8)-Contact (8P8C) module that accepts 8P8C plugs.
   3. When utilized as part of a channel or permanent link, all high performance modular connectors shall match the horizontal cable performance transmission requirements before and after installation as specified in ANSI/TIA-568 Commercial Building Telecommunications Cabling Standard (horizontal cable section) in all noted performance parameters.

C. Accessory Products:
   1. Provide any accessory products related to the UTP connectors required to provide a complete and functional infrastructure system.

2.07 INDOOR MULTIMODE OPTICAL FIBER CONNECTORS

A. Manufacturer List:
   1. Corning
   2. Ortronics
   3. Belden

B. Description:
   1. All indoor multimode optical fiber connectors shall be LC-type connectors, rated and approved by the manufacturer to perform at the level designated by the optical fiber strands being terminated.
   2. The connector shall be field installable type.
   3. Connector shall have a fiber stub in the ceramic connector ferrule that is bonded in the ferrule micro-hole, the connector shall not require end face polishing in the field, and the end tip shall be Ultra Physical Contact (UPC) type.
   4. The connector crimp-on mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants.
   5. When tested in accordance with FOTP-171, the connector shall be consistently capable of insertion losses ≤ 0.1 dB (typical) and shall be ≤ 0.5 dB (maximum) when installed in accordance with the manufacturers recommended procedure.

C. Accessory Products:
   1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.08 OUTDOOR MULTIMODE OPTICAL FIBER CONNECTORS

A. Manufacturer List:
   1. Corning
   2. Ortronics
   3. Belden

B. Description:
   1. All outdoor multimode optical fiber connectors shall be ST-type connectors, rated and approved by the manufacturer to perform at the level designated by the optical fiber strands being terminated.
   2. The connector shall be field installable.
   3. Connector shall have a fiber stub in the ceramic connector ferrule that is bonded in the ferrule micro-hole, the connector shall not require end face polishing in the field, and the end tip shall be Ultra Physical Contact (UPC) type.
   4. The connector crimp-on mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants.
   5. When tested in accordance with FOTP-171, the connector shall be consistently capable of insertion losses $\leq$ 0.1 dB (typical) and shall be $\leq$ 0.5 dB (maximum) when installed in accordance with the manufacturers recommended procedure.

C. Accessory Products:
   1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.09 SINGLE MODE OPTICAL FIBER PIGTAIL CONNECTOR ASSEMBLIES

A. Manufacturer List:
   1. Corning
   2. Ortronics
   3. Belden

B. Description:
   1. Single-mode Optical fiber pigtail connector assemblies housed in manufacturers connector panels.
   2. LC style connectors.
   3. Maximum insertion loss across mated pair shall be less than 0.3 dB, tested per FOTP-171 Method A. Typical Insertion loss should be maximum of 0.15 dB.
   4. Minimum return loss shall be less than 60.5 dB, tested per FOTP-171. Typical return loss should be 60 dB.
   5. Pigtails shall have minimum 2 meters of attached cordage.
   6. Pigtails shall be assembled and tested by the connector manufacturer.

C. Accessory Products:
   1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.10 SINGLE MODE OPTICAL FIBER FUSION SPLICE-ON CONNECTOR ASSEMBLIES

A. Manufacturer List:
   1. Corning
   2. Ortronics
   3. Belden

B. Description:
   1. Single-mode optical fiber fusion splice-on connector assemblies.
   2. LC style connectors.
   3. Maximum insertion loss across mated pair shall be less than 0.3 dB, tested per FOTP-171 Method A. Typical Insertion loss should be maximum of 0.15 dB.

4. Minimum return loss shall be less than 60.5 dB, tested per FOTP-171. Typical return loss should be 60 dB.

C. Accessory Products:
1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.11 OUTLET HOUSING COMPONENTS

A. Manufacturer List:
1. Ortronics
2. Leviton
3. Belden

B. Description:
1. All outlet housings at the various technology outlet locations shall provide the designated number modular insert ports as indicated in the T-series drawings.
2. All flush-mounted faceplates shall be provided per the port configuration as shown on the telecom drawings.
3. Faceplates for wall-mounted phones shall be one (1) port single gang faceplates that have wall-mount lugs allowing vertical phone mounting.
4. Faceplates for flush floor mounted outlets shall be coordinated with the floor box or poke thru device that will be selected and installed outside the scope of this section.
5. System furniture faceplates shall be capable of fitting in the furniture system selected by Owners Representative. Furniture faceplates shall be provided per the port configurations shown on the telecom drawings. Furniture faceplate extenders shall be used (if required) to maintain proper bend radii within the furniture raceway/pathway.
6. Surface mounted boxes shall be capable of the quantity of outlet jack requirements at each outlet locations indicted in the T-series drawings.
7. All outlet-housings shall provide a clear ANSI/TIA-606 labeling location for both the individual outlet port and the entire outlet housing location, unless otherwise indicated in the project drawings.

C. Accessory Products:
1. Provide any accessory products related to the workstation outlet housing components required to provide a complete and functional infrastructure system.

2.12 OPTICAL FIBER COUPLERS AT WORKSTATION OUTLET LOCATIONS

A. Manufacturer List:
1. Ortronics
2. Leviton
3. Belden

B. Description:
1. The optical fiber couplers shall be LC-style small form factor and manufactured by the same manufacturer of the workstation outlet housing.
2. Ensure coupler size and type is compatible with the specified optical fiber cable and outlet housing at each outlet location.
3. Provide angled type couplers.
4. Optical fiber couplers shall not limit the functionality or performance of the optical fiber cables or connectors when installed at each outlet location.

C. Accessory Products:
1. Provide any accessory products related to the workstation outlet optical fiber termination connectors and coupler components required to provide a complete and functional infrastructure system.

2.13 RG-11 F-TYPE CONNECTORS

A. Manufacturer List:
1. Belden
2. Thomas & Betts

3. Hubbell

B. Description:
   1. RG-11 coaxial connectors shall be sealed to prevent moisture from migrating into the connector and have three hundred sixty (360) degree radial compression.
   2. All coaxial connections shall have a minimum cable retention rating of forty (40) pounds.
   3. All modular outlet coaxial connectors shall function to the specified performance parameters for video signal traffic that is connected via video patch cords in the IDF(s), Head End and/or MDF.
   4. Ensure connector size and type is compatible with the specified RG-11 backbone cable.
   5. Utilize corrosion resistant connectors when applicable.

C. Accessory Products:
   1. Provide any accessory products related to the coaxial cabling termination connectors required to provide a complete and functional infrastructure system.

2.14 RG-6 F-TYPE CONNECTORS

A. Manufacturer List:
   1. Belden
   2. Thomas & Betts
   3. Hubbell

B. Description
   1. RG-6 coaxial connectors shall be sealed to prevent moisture from migrating into the connector and have three hundred sixty (360) degree radial compression.
   2. All coaxial connections shall have a minimum cable retention rating of forty (40) pounds.
   3. All coaxial connections shall be manufactured with RG-6 F-type interface that is compatible with components specifically manufactured for RG-6 F-type threaded ports.
   4. All modular outlet coaxial connectors shall function to the specified performance parameters for video signal traffic that is connected via video patch cords in the IDF(s), Head End and/or MDF.
   5. Ensure connector size and type is compatible with the specified RG-6 backbone cable.
   6. Utilize corrosion resistant connectors when applicable.

C. Accessory Products:
   1. Provide any accessory products related to the coaxial cabling termination connectors required to provide a complete and functional infrastructure system.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

B. Electrical requirements (conduit installation and capacity)

C. The telecommunications rooms are the size shown on the project drawings.
   1. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
   2. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 FOUR PAIR UTP CABLING INSTALLATION

A. Install all horizontal station cabling per the manufacturer’s recommended installation instructions, under the guidelines of ANSI/TIA-568 and BICSI best practices, and in quantities indicated in the T-series drawings.

B. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in BICSI best practices. Also refer to the cable manufacturer's specifications for exact cable requirements per the particular cable type.

C. Cable Bundles
   1. Bundling of cables is to be avoided; where bundling is necessary bundles shall be limited to no more than 24 cables.
   2. Allow cables to lay naturally in cable tray and runways whenever possible.
   3. Cables shall be neatly dressed from the point of emergence from vertical cable managers to the point of termination.

D. All cables shall be visually inspected for sufficient bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to Owner.

E. Contractor shall ensure that all industry standards and best practices are met, with special regard to maximum pair un-twist. No twisted pair cables shall have more than three-eight inch (3/8") of pair un-twist. The cable jacket shall be maintained as close as possible to the connecting hardware.

F. Install the horizontal cabling with attention paid to aesthetic means and methods when routing cabling within IT spaces. All horizontal cabling should terminate in their respective floor serving technology space; specifically cables from floor outlets need to terminate in their corresponding floor telecom room.

G. All cabling distributed horizontally through metal stud framing shall have plastic protective bushings inserted to protect cables prior to installation.

H. All cables shall be clearly labeled on both ends and in an accessible location no more than six inches (0'-6") from the cable ends.

I. Owner reserves the right to specify a new location for any outlet or equipment without increasing contractor unit cost – providing that the new location is specified prior to roughing-in of technology cable and is not farther than ten (10) feet away from the original location specified.

3.03 HORIZONTAL OPTICAL FIBER (SMF AND LOMMF) CABLE

A. Install all horizontal cable per the manufacturer's recommended installation instructions, under the guidelines of ANSI/TIA/EIA-568 and BICSI best practices, and in quantities indicated in the T-series drawings.

B. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. The cable manufacturer's specifications for each particular cable type shall be followed exactly.

C. Cable shall be visually inspected for sufficient bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to Owners Representative.

D. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in BICSI guidelines.

E. Install cables with attention paid to aesthetic means and methods when routing cabling within IT spaces. No cable shall be left unsupported for more than four (4) feet vertically or horizontally at any time.

F. Fiber optic cables shall be placed in neat bundles separated from other communications cabling. Fiber optic cables shall be neatly placed and lashed with Velcro ties to the horizontal and vertical cable management and runways at minimum 4-foot intervals, not to exceed every 4th rung, plus all locations where the cables change direction.

G. Provide radius drop out fittings at all locations where fiber optic cables transition from vertical to horizontal cable management systems.

H. All cable shall be securely fastened to the termination shelf with a manufacturers strain relief bracket and termination panel cable clamp in a way that does not damage the optical fiber strands or impede the performance of the media. This secure fastening method shall also serve to insure a secure termination environment.

I. A minimum of three feet (3'-0") of each optical fiber strand shall be left protected within the termination shelf for any future re-termination of a particular optical fiber strand.

J. All cables shall be clearly labeled on both ends and in an accessible location no more than one (1) foot from each cable end.

3.04 RG-6 HORIZONTAL CABLE

A. Install all RG-6 coaxial per the manufacturer's installation instructions and ANSI/TIA-568 standards, and in quantities indicated in the T-series drawings.
B. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. The cable manufacturer's specifications for each particular cable type shall be followed exactly.
C. RG-6 coaxial cable shall be visually inspected for sufficient bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to the owner.
D. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in BICSI best practices.
E. Install RG-6 coaxial cables with attention paid to aesthetic means and methods when routing cabling within IT spaces. No cable shall be left unsupported for more than five (5) feet vertically or horizontally at any time.
F. All RG-6 coaxial cables shall be clearly labeled on both ends and in an accessible location no more than one (1) foot from each cable end.

3.05 COPPER UTP CONNECTORS

A. Process:
   1. Install all connectors per ANSI/TIA-568 standards, BICSI Best Practices, and manufacturer instructions.
   2. The installation and performance parameters of all installed couplers and connectors shall be verified by the trade contractor through ANSI/TIA-568 testing procedures.

3.06 OUTLET HOUSINGS

A. Process:
   1. Color of all outlet housing components shall be coordinated with Owners Representative before purchase and installation.
   2. All technology outlets located on walls shall be flush mounted, level and plumb.
   3. All technology outlets shall be mounted at right angles and parallel to the floor, unless installation requirements or design dictate otherwise.
   4. Install blank inserts in outlet housing spaces that are not being filled with cable termination modules. Blank inserts shall match the workstation housing color, unless otherwise indicated in the T-series drawings.
   5. All outlets located in systems furniture may be served from a wall adjacent to the furniture cluster or a floor box. If the cable is exposed prior to entering furniture raceway, install spiral wrap tubing to protect the cable per the manufacturer's recommendations.
   6. All outlet housings as well as each individual utilized port shall be labeled in accordance with Owners Representative approved labeling scheme.

3.07 OPTICAL FIBER CONNECTORS AND COUPLERS

A. Process:
   1. Install all couplers per ANSI/TIA-568 standards, BICSI Best Practices, and manufacturer instructions.
   2. The installation and performance parameters of all installed couplers and connectors shall be verified by the trade contractor through ANSI/TIA-526 testing procedures.

3.08 RG-11, RG-6, QR 540 CONNECTORS

A. Install all connectors and required couplers per the manufacturer's installation instructions and ANSI/TIA-568 standards, and in quantities indicated in the T-series drawings.
B. The installation and performance parameters of all installed connectors shall be verified by the contractor through ANSI/TIA-568 testing procedures for each connector.

3.09 RE-INSTALLATION

A. Refer to Section 27 00 00 Communications. - PART 3.7

3.10 CLOSEOUT ACTIVITIES

A. Refer to Section 27 00 00 Communications. - PART 3.8

END OF SECTION

SECTION 275116
PUBLIC ADDRESS SYSTEMS

PART 31 - GENERAL

31.01 SUMMARY

A. Section includes equipment for amplifying, distributing, and reproducing sound signals. The sound system will provide for the amplified distribution of program material to the outlined speaker systems. Program origination will be from system sources and/or other sources outlined in this Section.
B. The systems to be installed shall include the following:
   1. Speakers and cabling to expand the existing “Voice of Metra” System that is to be relocated.

31.02 DEFINITIONS

A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
B. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.
C. VU: Volume unit.

31.03 SUBMITTALS

A. Product Data: For the following:
   1. Loudspeakers.
B. Shop Drawings:
   1. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.
   2. Wiring Diagrams: Power, signal, and control wiring. Include the following:
      a. Identify terminals to facilitate installation, operation, and maintenance.
      b. Single-line diagram showing interconnection of components.
      c. Cabling diagram showing cable routing.
C. Calculations: For sizing backup battery.
D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
E. Qualification Data: For Installer.
F. Field quality-control test reports.
G. Operation and Maintenance Data: For public address and music equipment to include in emergency, operation, and maintenance manuals.

31.04 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Installer must have been in business a minimum of five (5) years and have a minimum of five (5) similar installations.
B. Source Limitations: Obtain public address and music equipment through a single source authorized by manufacturer to distribute each product.
C. Comply with UL 50.

31.05 DELIVERY, STORAGE, AND HANDLING

A. Do not install electronic components until major construction work in the area is complete. Do not install in areas where dust or moisture can contaminate the working parts or where finish can be marred by construction work.
B. Stage materials in a secure area of the project site until installation. Materials and items shall be placed so that they are protected from damage and deterioration.

31.06 COORDINATION

A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 32 - PRODUCTS

32.01 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Functions: Include the following:
   1. Relocation and Expansion of the Existing Voice of Metra System.

32.02 EQUIPMENT AND MATERIALS

A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
B. Equipment: Modular type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
C. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

32.03 SPEAKER SYSTEMS

A. Pole Mount: Bogen A2TBLK with backboxes and supports.
B. Flush Ceiling Mount: Bogen S86T725PG8U/W (white) with backboxes and supports.

32.04 SYSTEMS CABLE

A. Speaker Cable:
   1. West Penn 226
   2. Belden 5100
   3. OSD JA-14-2-PAR

32.05 PATHWAYS

A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

PART 33 - EXECUTION

33.01 INSTALLATION

A. Wiring Method: Install wiring in raceways except within consoles, desks, and counters. Conceal raceways except in unfinished spaces.
B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess. Use lacing bars in cabinets.
C. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
E. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
F. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
G. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
H. Wall-Mounting Outlets: Flush mounted.
I. Floor-Mounting Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.
J. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
K. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
L. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
M. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical Systems."

33.02 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
   1. Do not ground microphone line shields, except at microphone frame and at console input connectors.
   2. Ground other shields of two-conductor cables only at one (1) end, as appropriate. Terminate “floating” ends with wedge-on collars, plastic tape, or heat-shrinkable tubing.
   3. Maintain continuity of shields at all connecting points.
B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding. Connect all audio grounds in an equipment rack to a common point.

33.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Schedule tests with at least seven days' advance notice of test performance.
   2. After installing public address and music equipment and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
   4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
      a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
      b. Repeat test for each separately controlled zone of loudspeakers.
      c. Minimum acceptance ratio is 50 dB.
   5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier

channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.

6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
8. Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Retesting: Correct deficiencies, revising tap settings of speaker-line matching transformers where necessary to optimize volume and uniformity of sound levels, and retest. Prepare a written record of tests.

C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

33.04 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

33.05 CLEANING

A. On completion of installation inspect exposed finishes. Remove burrs, dirt, paint spots, and construction debris. Repair damaged finish(es), including chips, scratches, and abrasions.

B. All equipment, hardware and finishes shall be cleaned prior to final acceptance. Unless otherwise indicated, clean shall mean free of dust, dirt, mud, debris, oil, grease, residues, and contamination.

C. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion. Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps. Cover fixtures, materials, equipment and devices furnished or installed under this Section or otherwise protect against damage, both before and after installation. Hardware, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced.

D. During the course of installation work, provide for on-going proper disposal of all debris, including but not limited to: equipment packaging and shipping materials, shipping pallets, empty cable reels/boxes, cable cuttings, etc. The Contractor shall, at all times, keep the site free from accumulations of waste material or rubbish caused by its employees or work. Remove all crates, cartons, and other waste materials or trash from the working areas at the end of each working day. Flammable waste material must be removed from the working areas at the time of generation. All rubbish and debris, combustible or not, shall be discarded in covered metal containers daily and removed from the premises at least weekly and legally disposed of.

33.06 CONTRACTOR STARTUP AND REPORTING

A. Startup Service: Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements. Complete installation and startup checks according to manufacturer's written instructions.

B. Demonstration: Train Owner's maintenance personnel to adjust, operate, and maintain public address and music equipment. Refer to Division 01 Section "Demonstration and Training." Schedule training with at least seven days advanced notice.

END OF SECTION

SECTION 280500
COMMON WORK RESULTS FOR SAFETY AND SECURITY

PART 1 - GENERAL
1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 WORK INCLUDED IN THE LOW VOLTAGE COMMUNICATIONS CONTRACT

A. The mention of an Article, operation or method requires that the Low Voltage Contractor shall provide same and perform each operation in accordance with the conditions stated. The Low Voltage Contractor shall provide material, labor, equipment and transportation to complete the project in compliance with the Contract Documents to provide a complete and fully functional installed system.
B. Work shall be installed in accordance with State and Local Inspection Authorities having jurisdiction together with the recommendations of the manufacturer whose equipment is to be supplied and installed under this Contract.
C. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
D. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and the Low Voltage Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades. The Low Voltage Contractor, in conjunction with the Architect, Engineer, and Owner's representative, shall establish exact locations of materials and equipment to be installed. Consideration shall be given to construction features, equipment of other trades and requirements of the equipment proper.
E. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
F. Before submitting a bid, each bidder shall examine the drawings relating to their work and shall become informed as to the extent and character of the work required and its relation to other work in the building.
G. This project will be phased, as defined by the Owner and Architect. This will necessitate the provision of temporary cabling and connectivity to maintain newly constructed and existing areas of the project that may be affected by the phasing of construction. The Low Voltage contractor shall be responsible for providing, installing and removing all temporary cabling and connectivity as required in their original bid. All associated appurtenances with the utilities shall be provided as part of this project.
H. Materials shall be suitably stored and protected prior to installation and work shall be protected after installation, during construction and prior to acceptance.

I. The Low Voltage Contractor shall furnish scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of equipment and apparatus required to be installed by the Low Voltage Contractor. This equipment shall be removed by the Low Voltage Contractor upon completion of the project.

1.03 DEFINITIONS

A. The Owner. The individual who the Owner selects as the project representative.
B. The Engineer. dbHMS, Inc.
C. The General Contractor. The contractor responsible for the construction of the project, general trades and building system subcontracting (HVAC, Electrical, Plumbing, Fire Protection, etc.)
D. The Low Voltage Contractor. The low voltage communications systems contractor.
E. Provide. Used within these sections "provide" shall mean "furnish and install." "Furnish" shall mean "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "install" shall mean "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."
F. Exposed. Exposed to view in room, corridor or stairway.
G. Code. National, State and Local Electrical codes including OSHA requirements.
H. Substitution. Manufacturer or method other than those listed by name in these specifications, on the drawings, or in an addendum.
I. Signal voltage. NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.
J. Low voltage. 50 to 600 volts.
K. Medium voltage. 601 to 35,000 volts.
L. High voltage. 35,001 volts and greater.
M. Electrical ductbank. Assembly consisting of electrical conduits encased in concrete.

1.04 ABBREVIATIONS

A. A/E: Architect or Engineer
B. ANSI: American National Standards Institute
C. ASTM: American Society for Testing Materials
D. BICSI: Building Industry Consulting Services International
E. EIA: Electronic Industries Alliance
F. ENGR: Engineer
G. IEEE: Institute of Electrical and Electronic Engineers
H. NEC: National Electrical Code
I. NEMA: National Electrical Manufacturer's Association
J. NFPA: National Fire Protection Association
K. OSHA: Occupational Safety and Health Administration
L. TIA: Telecommunications Industry Alliance
M. UL: Underwriter's Laboratories

1.05 PERMITS AND LICENSES

A. The Low Voltage Contractor shall prepare and submit applications and working drawings to authorities having jurisdiction over the project. Licenses and permits required shall be secured and paid for by the Low Voltage Contractor.

1.06 STANDARDS AND CODES

A. Work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. Comply with applicable OSHA regulations.
B. Work shall be installed in accordance with BICSI, IEEE, ANSI, and TIA/EIA standards.
C. Materials shall have a UL or ETL label where a UL or ETL Standard or test exists.

1.07 DIMENSIONS AND DEFINITE LOCATIONS

A. The drawings depicting communications systems work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact

location of equipment and devices shall be established in the field in accordance with instructions from the Architect as established by manufacturer's installation drawings and details.

B. The Low Voltage Contractor shall refer to shop drawings and submittal drawings for equipment requiring communications connections to verify rough-in and connection locations.

C. Unless specifically stated to the contrary, no measurement of a communications drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the communications drawings are subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.

D. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

1.08 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of installation and removal of the equipment with minimum interference to other installations or equipment.

B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.09 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Division 27 must be coordinated.

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

E. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.10 DRAWINGS/ RECORD DOCUMENTS

A. The Low Voltage Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing each feeder, pull box and protective device. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner and Engineer in both electronic and hard paper copy formats. Record drawings shall also include:
   1. Locations of buried conduit or similar items. Include buried depth.
   2. Field changes of dimension or detail.
   3. Changes made by field order or change order.
   4. Details not on original contract drawings.

B. As Built Drawings – Refer to the individual Division 27 Specification Section for As-Built Drawing requirements.
C. In the event of a conflict between the drawings and specifications, this Contractor shall base their bid on the greater quantity, cost or quality of the item in question, unless conflict is resolved by an addendum.
D. Take photographs of all concealed equipment in gypsum board ceilings, shafts, underground (buried) piping routes and supports and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation for each photo. These shall become part of Record Documents.
E. Underground and utility work shall be located by distances to landmarks, such as building foundations. Give actual dimensions of everything installed including elevations and elevations at each change in direction.
F. Drawings shall also show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall incorporate actual manufacturer and make and model numbers of final equipment installation.
G. THE ENGINEER/ARCHITECT WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
H. When required by the jurisdiction, each trade shall submit the record set for approval by the building department in a form acceptable to the department. Any document format size changes, and supplemental information required for the submittal are the responsibility of the contractor.
I. Quality of Record Documents shall equal or exceed that of original Contract Documents.
J. The record documents shall be submitted in electronic media format to the Architect/Engineer for review and approval, prior to Application for Final Payment.

1.11 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are ambiguous, advise the Architect in writing before Award of Contract. Otherwise, the Architect/Engineer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.
B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert the Architect in writing before installation. Otherwise, make changes in installed work as the Architect requires within Contract Price.
C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.
D. It is the requirement of these Contract Documents to have the contractor provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Low Voltage Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Low Voltage Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

1.12 DELETED

1.13 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of Division 27. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
B. The Low Voltage Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to

install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.

1.14 EXISTING CONDITIONS AND PREPERATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Divisions/ Sections or other Contracts or by the Owner. Report conditions that might affect work adversely, in writing, through the General Contractor to the Architect via RFI. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. The documentation of existing conditions was derived from As-Built documents and is in part unverified. Actual existing conditions shall be verified prior to commencement of work.

1.15 UTILITY CHARGES

A. Include utility fees and charges for any temporary voice, data and CATV services.

B. Include utility fees and charges for any required work by the voice, data and CATV service providers for the completion of the project.

C. Utility costs for permanent service shall be paid by the Owner.

1.16 TEMPORARY/ CONTINUITY OF UTILITY SERVICES

A. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.

B. Do not interrupt existing utility services without written Owner's approval.

C. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

D. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

E. Contractor shall coordinate any shutdowns of existing systems as follows:
   1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.
   2. Minimize timeline of shutdowns of any system.
   3. Provide temporary services where required and perform shutdowns and tie in’s at a time convenient to Owner.
   4. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
   5. Perform required survey and inspection work required by the notice for shutdown.

F. Provide all necessary material, tools, and labor as required for the provisions of temporary services.

G. Include premium time work associated with interruptions of services and/or shutdowns as necessary to avoid disruption to Owner's operations.

H. For communications work associated with any service provider, coordinate with the appropriate service provider.

I. Complete the following form, indicating what is being included as part of this bid, and this project.

J. For work involving an independent utility company (i.e., non-owner provided utility), Contractor shall coordinate directly with the utility provider all aspects of related work, including shutdowns, tie-ins, capacity impacts, etc.

1.17 MATERIALS AND EQUIPMENT

A. Materials and equipment required shall be new.

B. Equipment supplied shall be based on materials and equipment of manufacturers specified. No substitutions are allowed except as permitted in this specification.

C. Items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute the current product.

1.18 PROTECTION OF WORK

A. Each low voltage contractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment, which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

B. Each separate contractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

1.19 SUBSTITUTIONS

A. Substitutions shall not be allowed.

1.20 SUBMITTALS

A. Definitions:
   1. Shop Drawings are information prepared by the Low Voltage Contractor to illustrate portions of the work, such as ductwork layout arrangements, in more detail than shown in the Contract Documents.
   2. Submittals are a compilation of product data cutsheets fully describing performance, size, connections, color selection, etc., as provided by the manufacturer.

B. Submittal Procedures and Format
   1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review. Submit reproducible drawing and two blue- or black-line reproductions of each Shop Drawing larger than 8-1/2 x 11. Submit four sets of each smaller shop drawing. After review, reproducible original of each large Shop Drawing and three sets of each small shop drawing will be returned with reviewer's marks.
   2. Submittals and shop drawings shall be submitted COMPLETE, by trade, in heavy-duty three-ring binders. Each binder shall include a Table of Contents identifying each section. Each section shall be arranged in order of specification section and tabbed accordingly. Each item submitted shall reference the article and paragraph of its specification section. Each item specified shall be addressed. If specified item will not be used, state so in submittal with brief explanation. In the instance when a resubmission is necessary, resubmit only the items required; a complete resubmittal containing previously approved data is not required.
   3. Provide additional copies of approved submittals/shop drawings as required for full distribution.
   4. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
   5. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

C. Required Use of Acceptable Manufacturers on this Project:
   1. Substitution of products other than those of the Acceptable Manufacturers specified herein shall not be made. Only the specified items or the comparable product by one of the specified Alternate Manufacturers shall be submitted. Products by other manufacturers shall not be used on this project.
   2. Listing of a manufacturer's name for a particular material or piece of equipment does not imply acceptance of all of that manufacturer's products. Use of more than one

manufacturer to supply any specific material or equipment shall have prior approval of the Architect/Engineer.

D. Deviations
   1. Concerning deviations other than substitutions, proposed deviations from Contract Documents should be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of submittals/shop drawings which flags the deviation to the attention of the Architect.
   2. Without letters flagging the deviation to the Architect, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved submittals/shop drawings containing the deviation, and will be strictly enforced.
   3. Approval of proposed deviations, if any, will be made at the discretion of the Architect.
   4. Where equipment or methods different than those specified are submitted by this Low Voltage Contractor and approved for use by the Engineer and Owner, the installation shall be in full conformance with the intent of these Contract Documents. All costs related to the use of the different method and/or equipment shall be paid by this Low Voltage Contractor.

E. Responsibility
   1. Intent of Submittal review is to check for capacity, rating, and certain construction features. The Low Voltage Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with submittal notations to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor shop drawing errors or deviations from requirements of Contract Documents. The Architect's/Engineer’s noting of some errors while overlooking others will not excuse the Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
   2. INFORM SUBCONTRACTORS, MANUFACTURERS, SUPPLIERS, ETC., OF SCOPE AND LIMITED NATURE OF REVIEW PROCESS AND ENFORCE COMPLIANCE WITH CONTRACT DOCUMENTS.
      a. The Engineer’s obligations to review shop drawings and other submittals and to return them in a timely manner are conditioned upon the prior review and approval of the shop drawings or submittals by the Low Voltage Contractor as required in the construction contract and the Low Voltage Contractor’s submittal of the shop drawings and other submittals in accordance with a written schedule distributed in advance to the Engineer identifying the dates for the submittal of the various shop drawings and submittals.

F. Schedule: Incorporate submittal review period into construction schedule so that Work is not delayed. The Low Voltage Contractor shall assume full responsibility for delays caused by not incorporating the following submittal review time requirements into his project schedule. Working days listed reference the time in the Engineer's office. If more than five submittals/shop drawings of a single trade are received in one week, allow at least five (5) additional working days, exclusive of transmittal time, for review, each time a submittal/shop drawing is submitted or resubmitted.

G. Multiple Re-submittals: The Engineer will review the first submittal from the low voltage contractor and respond with comments, and will review one re-submittal for the same item(s) from the contractor and respond with comments. If the contractor is required to make subsequent submittals for the same item(s) the Engineer shall be compensated by the contractor for the time to review each subsequent re-submittal.

1.21 SHOP DRAWINGS AND EQUIPMENT BROCHURES

A. Submit to Engineer for review, the manufacturer's shop drawings and equipment brochures in quantities determined by the Engineer and specified in the appropriate sections.

B. Data submitted for Engineer's review shall be numbered consecutively, shall be noted to correlate with the electrical drawings and shall bear:
   1. The name and location of the project.
   2. The name of the Contractor.
   3. The date of submittal.
   4. The date of the drawings and the date of each correction and revision.

C. Shop drawings for different systems and equipment shall, be bound separately by specification section and not bound by manufacturer. Submittals which contain different specification section systems bound together shall be returned unreviewed for resubmittal.

D. No materials or equipment subject to prior review by the Engineer shall be fabricated or installed by the Low Voltage Contractor, without approval. The Engineer's review of shop drawings shall not relieve the Low Voltage Contractor of responsibility for deviations from the requirements of the drawings and specifications, unless prior approval for deviations has been granted.

1.22 MAINTENANCE MANUALS

A. Obtain at time of purchase of equipment, three copies of operation and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.

B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
   1. Copies of all approved submittals/shop drawings.
   2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.
   3. Riser diagrams.
   4. Wiring diagrams.
   5. Test records.
   6. Owner's written acknowledgement of satisfactory completion of instruction period.

C. The operation manuals and instructions to the Owner are of prime importance and shall be provided prior to request for final payment.

D. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.

E. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions. Owner shall determine which systems require additional instructions. Duration of instructions shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions.

F. If it is desired to provide maintenance manuals in PDF format, the low voltage contractor shall provide a written request prior to submitting the manuals indicating which equipment manuals they propose to provide in this format.

1.23 CLEANING AND PAINTING

A. Rubbish resulting from this work shall be removed and disposed of on a daily basis in manner as to be acceptable to the Architect and Owner.

B. The Low Voltage Contractor shall clean exposed work and equipment, the interior and exterior of cabinets and pull boxes, etc., and remove rubbish and debris resulting from the work.

C. Where painted surfaces of equipment have been damaged or rusted during construction, the Low Voltage Contractor shall repair and paint to match original finish.
D. Clean other equipment indicated in other sections of the specification for specific equipment.
E. Cleaning shall be performed prior to system start-up.
F. Equipment
   1. After completion of project, clean the exterior surface of all equipment, including concrete residue, dirt, paint residue, etc.

1.24 TESTS AND ACCEPTANCE

A. The operation of the equipment and communications systems does not constitute an acceptance of the work. The acceptance is to be made after the Low Voltage Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
B. Tests and Acceptance procedures shall adhere to those specified within each Division 27 Specification Section.
C. In the presence of the Engineer and the Owner, the Low Voltage Contractor shall demonstrate the proper operation of miscellaneous systems.
D. Perform other test as specifically stated in other sections of the specification for specific equipment.

1.25 NOT USED

1.26 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. To connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access panels required by code or otherwise to electrical service equipment shall be supplied and installed by Electrical Contractor. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.27 DELETED

1.28 OWNER TRAINING

A. As part of this contract, the contractor shall include all labor and materials to train the building Owner on the electrical systems installed. The contractor shall be responsible for recording video and audio all Owner training.
B. Owner training shall adhere to the training specified in each Division 27 Specification Section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Refer to each specific Division 27 Communications specification section for specific details.
B. Perform work such that progress of the entire project including the work of other disciplines and Divisions shall not be interfered with or delayed.

2.02 SPECIAL RESPONSIBILITIES

A. Installation Only Items:
   1. Where the Low Voltage Contractor is required to install items which he does not purchase, he shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation.

2. The Low Voltage Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted, this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

B. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

C. Use of premises: Use of premises shall be restricted as directed by Architect and as noted below.
   1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Maintain building and premises in neat and clean condition, and perform cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Architect.
   2. Store materials in a manner that will maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
   3. Do not interfere with function of existing sewers and water and gas mains, electrical or mechanical systems and services. Extreme care shall be taken to prevent debris from entering pipe, ductwork and equipment. Confer with Architect as to disruption of services or other utilities due to testing or connection of new work to existing. Interruption of services shall be performed at time of day or night deemed by Owner to provide minimal interference with normal operation. Obtain Owner's approval of the method proposed for minimizing service interruption.

2.03 FIRESTOPPING

A. Fire stopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent mastic wrap strips, and firestop pillows. Materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by that agency.

B. Materials using solvents or that requiring hazardous waste disposal shall not be used.

C. The firestop assemblies shall meet fire test and hose stream test requirements of an independent testing agency.

D. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for extra cost to Owner.

E. A single firestopping manufacturer shall be utilized throughout the project. The firestopping manufacturer shall be decided by the General Contractor. All products and methods used on the project for firestopping shall be approved by the General Contractor.

F. Typical Acceptable manufacturers:
   1. 3M Corporation.
   2. Hilti
   3. STI

2.04 SLEEVES FOR RACEWAYS AND CABLES

A. General:
   1. Lay out penetration and sleeve openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.
   2. Provide sleeves and packing materials at all penetrations of foundations, walls, slabs (except on-grade), partitions and floors. Sleeves shall meet U.L. rated assembly requirements and materials requirements of these specifications.

3. Sleeves that penetrate outside walls, basement slabs, footings and beams shall be waterproof.
4. Coordinate work carefully with architectural and structural work. Provide core drilling as necessary if walls are poured or otherwise constructed, without sleeves and a wall penetration is required. Provide core drilling as required for penetrations of existing construction. Do not penetrate structural members without Structural Engineer's/Architect's approval.
5. Submit a list of the U.L. Listed details that the Contractor intends on using on this project, in all rated walls.
6. Where sleeves/ cabling passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.
7. Identify unused sleeves and slots for future installation.
8. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of pipe, duct, conduit or cable.
9. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes.
10. Sleeves through floors shall be watertight and shall extend 2 inches above floor surface.
11. Submit and coordinate with all trades complete penetration layout drawings showing all openings in building structural members including floor slabs, walls, bearing walls, foundation walls, shear walls, roof penetrations, etc. Indicate and locate, by dimension, all openings that shall be sleeved. Drawings shall be approved by Structural Engineer prior to the preparation of any opening in a structural member. Provide 24-gauge galvanized steel sleeves for all walls, floors, including foundation, stem and exterior walls.
12. All penetrations into libraries, auditoriums, conference rooms, sleep rooms, etc., must utilize an acoustical sealant in addition to any other sealants required for wall ratings.
13. Contractor shall maintain complete integrity of all completed waterproofing, weatherproofing, fire rating, and penetrations during construction.

B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends with plastic bushing on each of the sleeve.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.05 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

B. Installation Testing, Listings and Approvals
   1. Installation shall meet material manufacturer's recommendations exactly, particularly regarding safety, ventilation, removal of foreign materials and other details of installation.

Dam openings as recommended. Remove flammable materials used for damming and forming seals in fire-rated construction.

2. Sleeve penetration methods shall be water- and gas-tight and shall meet requirements of ASTM E-119 Standard Methods of Fire Tests of Building Construction and Materials.
3. Fire-stop penetration seal methods and materials shall be FM-approved and UL-listed as applicable.
4. Inspect foamed sealant to ensure manufacturer's optimum cell structure and color ranges.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Materials and Workmanship
   1. Work shall be neat and rectilinear. Cabling shall run concealed except in communications rooms and areas where no hung ceiling exists. Install material and equipment as required by manufacturers. Installation shall operate safely, without undue wear, noise, vibration or corrosion. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.
   2. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation.
   3. Finish of materials, components and equipment shall be as approved by Architect and shall be resistant to corrosion and weather as necessary.
   4. The Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

G. Delivery, Storage and Handling
   1. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer’s original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
   2. The Low Voltage Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building “dry-in”, to prevent any damage resulting from inclement weather or construction traffic. Sheet metal/specialties shall not be stored outdoors.
   3. Equipment exposed to weather during shipping and/or storage on site shall be plastic shrink-wrapped by the manufacturer to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation.
   4. Prevent dirt and construction debris from accumulating inside equipment (including pipe and conduit, ductwork, fittings, etc.).
   5. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.
   6. Equipment/materials shall be handled and installed in accordance with manufacturer’s instructions.

H. Provisions and Installation of Equipment
   1. For all equipment installed external to the building whether on roofs, supports, grade, etc., the installation must comply with wind loading and impact requirements of the applicable codes for this project site.

2. All equipment being furnished on this project, shall be certified by the manufacturer that the equipment item meets the applicable seismic, wind, and earthquake requirements as set forth by the Authority Having Jurisdiction overseeing this project.
3. Compliance with the above Paragraphs 2 can be reduced and/or eliminated if the equipment being provided is located inside a structural building enclosure, designed by a licensed professional Architect and Structural Engineer.
4. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Architect and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

3.02 FIRESTOPPING

A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300-21 and in accordance with local codes. The fire rating of the protective seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the construction is maintained. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."
B. Wall or floor penetrations openings shall be as small as possible.
C. Openings and annular spaces required by code to be protected shall be protected whether specifically indicated on the plans or not.
D. Installation of materials and assemblies shall be in strict accordance with the manufacturer's instructions.

3.03 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
E. Cut sleeves to length for mounting flush with both surfaces of walls.
F. Extend sleeves installed in floors 6 inches (150 mm) above finished floor level.
G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.04 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.
B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.05 DEMOLITION

A. Refer to all drawings for general description of areas requiring demolition.
B. Refer to General Contractor's/Construction Manager's Instructions for all existing equipment and materials that shall remain the property of the Owner.
C. Items of value which are not directed to be returned to the Owner shall become the property of the Low Voltage Contractor. Storage or sale of items on the project site is prohibited.
D. Protection: Ensure the safe passage of persons in and around the building during demolition. Prevent injury to persons and damage to property. Provide adequate shoring and bracing to prevent collapse. Immediately repair damaged property to the condition before being damaged. Take effective measures to prevent windblown dust.
E. Utilities: Maintain all utilities except those requiring removal or relocation. Keep utilities in service and protect from damage. Do not interrupt utilities serving used areas without first obtaining permission from the utility company and the Owner. Provide temporary services as required.
F. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work

3.06 PROJECT CLOSE-OUT PROCEDURE

A. Close-out documentation shall be provided at the end of the project. Close out documentation shall comply with each applicable Division 27 Specification Section.
B. It shall be each Contractor's responsibility to personally hand-deliver all of the required project close-out checklist items and to obtain Owner's authorized representative(s) signed receipt on all items requiring Owner sign-off.

3.07 OWNER TRAINING

A. Owner training shall comply with the requirements specified in each Division 27 Specification Section.
B. In general, training shall cover all aspects of the operation and human interface with the given system. Training shall include, but not be limited to;
    1. General description of the system and operating intent.
    2. Review and demonstration of all adjustments and programming available to the customer.
    3. Review of all system display screens and annunciation functions, both audible and visual.
    4. Review and demonstration of all required and recommended periodic system/equipment maintenance. Review shall include all required lockout and tagging procedures.
    5. Refer to individual specification sections for additional requirements associated with Owner training.
C. Training schedule shall be acceptable to the Owner and shall reflect the availability of Owner personnel. Schedule shall be provided 14 working days in advance of the first training session and shall be approved in writing by the Owner before final dates and times are set.
D. The contractor shall be responsible for video and audio taping of all training. Recording format shall be digital (.dvi files). Verify exact format with the owner prior to commencing. A copy of all training video files shall be included with each Operating and Maintenance manual. Additional copies, up to a maximum of three, shall be provided at the Owner’s request. Video files shall be copied to read only CD ROMS for distribution to the Owner.

END OF SECTION

SECTION 282300
VIDEO SURVEILLANCE EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. All security system shall meet or exceed the requirements put forth in this document.

1.02 RELATED WORK AND REQUIREMENTS

A. Division 26 Section – Grounding and bonding for Electrical Systems
B. Division 26 – Raceway and Boxes for Electrical Systems
C. Division 27 Section – Communication Horizontal Cabling
D. Division 28 Section – Common Work Results for Electronic Safety and Security

1.03 RESPONSIBILITIES

A. The Electrical Contractor shall be responsible for providing all back-boxes, pull-boxes, junction boxes, conduit, and sleeves as indicated in the plans and specifications to support the low voltage systems.
B. The Security Contractor shall be responsible for coordinating installation with general contractor and other trades on the job to insure surveillance devices, mounts and accessories are not impeding other system installations.
C. The term Security Contractor as used in this document refers to the company, group, or individual that has contract responsibility for implementing the terms and directives used in this specification document to produce the finished product as described here-in.

1.04 SUMMARY

A. Section includes a video surveillance system equipment consisting of cameras, power supplies, equipment racks and uninterruptible power supplies along with associated equipment.

1.05 DEFINITIONS

A. AGC: Automatic gain control.
B. BNC: Bayonet Neill-Concelman - type of connector.
C. B/W: Black and white.
D. CCD: Charge-coupled device.
E. FPS: Frames Per Second
F. FTP: File transfer protocol.
G. IP: Internet protocol.
H. IPS: Images Per Second
I. LAN: Local area network.
J. MPEG: Moving picture experts group.
K. NTSC: National Television System Committee.
L. PC: Personal computer.
M. PTZ: Pan-tilt-zoom.
N. RAID: Redundant array of independent disks.
O. TCP: Transmission control protocol - connects hosts on the Internet.
P. UPS: Uninterruptible power supply.
Q. WAN: Wide area network.

1.06 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 Insert requirement.

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."

1.07 SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. 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. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
   3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
   4. UPS: Sizing calculations.
   5. Wiring Diagrams: For power, signal, and control wiring.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

D. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, 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.

E. Field quality-control reports.

F. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Lists of spare parts and replacement components recommended being stored at the site for ready access.

G. Warranty: Sample of special warranty.

1.08 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 NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

1.09 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F(16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
   2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in

ambient temperatures of 36 to 122 deg F(2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.

3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 3R enclosures.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
7. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of cameras, equipment related to camera operation, and control-station equipment that fail within specified warranty period.
   1. Warranty Period: Three from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC and HDTV standard composite interlaced video.
B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
   1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
   2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits." as recommended by manufacturer for type of line being protected.
C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.02 CAMERAS

A. Acceptable Manufacturers:
   1. Avigilon
   2. Axis Communications AB
   3. Speco Technologies
B. 360-Degree Camera
   1. Imaging device: Progressive scan RGB CMOS
   2. Video Compression: H.264 (MPEG-4 Part 10/AVC), Motion JPEG
   3. Field of View
      a. @ 720p

1) Horizontal: 67°-36°
2) Vertical: 37°-20°

b. @ 1080p
1) Horizontal: 108°-54°
2) Vertical: 57°-30°

4. Resolution:
a. HDTV 720p
b. HDTV 1080p
5. Frame Rate:
a. 25/30 fps (50/60 Hz) @ 720p
b. 12.5/15 fps (50/60 Hz) @ 1080p
6. Video Streaming: Multiple
a. Individually configurable streams in H.264 and Motion Jpeg
b. Individually controllable frame rate and bandwidth
7. Image Settings
a. Resolution
b. Compression
c. Color Level
d. Brightness
e. Sharpness
f. Contract
g. White Balance
h. Exposure Control and Zones
i. Backlight Compensation
j. Shutter and Gain Fine Tuning of Behavior at Normal and Low Light
k. Image and Text Overlay
l. Privacy Mask
8. Lens: Varies by Camera Type, Refer to Plans for specific lens requirements.
9. Edge (Local) Storage: Micro SD/SDHC/SDXC Card
10. Application Programming Interface: Open API for software integration including ONVIF compliance
11. Event Actions:
a. File Upload: FTP, HTTP, network sare and/or e-mail
b. Notification: e-mail, HTTP and/or TCP
c. External output activiation
d. Video recording to edge (local) storage
e. Pre- and Post-alarm video buffering
12. Mermory: 1 GB RAM, 256 MB Flash
13. Power: Power Over Ethernet (POE) IEEE 802.3af Class 2
14. Connectors: RJ-45 10Base-T / 100Base-TX POE
15. Security:
a. Password Protection
b. IP Adress Filtering
c. HTTPS Encryption
d. Digest Authentication
e. User Access Log
16. Supported Protocols: IP{v4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ. FTP, CIFS/SMB, SMTP, Bonjour, UPnP, SNMPV1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
17. Operating Temperature: -4° to 122°F (-20° to 50°C)
18. Operating Humidity: 10% to 85%, noncondensing

C. Fixed Dome Camera / Fixed Camera
1. Imaging device: Progressive scan RGB CMOS
2. Video Compression: H.264 (MPEG-4 Part 10/AVC), Motion JPEG
3. Field of View

a. Horizontal: 84°-30°
b. Vertical: 63°-22°

4. Resolution:
   a. 1280 x 960
   b. 160 x 90
5. Frame Rate:
   a. 25/30 fps (50/60 Hz)
6. Video Streaming: Multiple
   a. Individually configurable streams in H.264 and Motion Jpeg
   b. Individually controllable frame rate and bandwidth
7. Image Settings
   a. Resolution
   b. Compression
   c. Color Level
   d. Brightness
   e. Sharpness
   f. Contract
   g. White Balance
   h. Exposure Control and Zones
   i. Backlight Compensation
   j. Shutter and Gain Fine Tuning of Behavior at Normal and Low Light
   k. Image and Text Overlay
   l. Privacy Mask
8. Lens: Varies by Camera Type, Refer to Plans for specific lens requirements.
9. Edge (Local) Storage: Micro SD/SDHC/SDXC Card
10. Application Programming Interface: Open API for software integration including ONVIF compliance
11. Event Actions:
    a. File Upload: FTP, HTTP, network sare and/or e-mail
    b. Notification: e-mail, HTTP and/or TCP
    c. External output activiation
    d. Video recording to edge (local) storage
    e. Pre- and Post-alarm video buffering
12. Mermory: 256 MB RAM, 128 MB Flash
13. Power: Power Over Ethernet (POE) IEEE 802.3af Class 2
14. Connectors: RJ-45 10Base-T / 100Base-TX POE
15. Security:
    a. Password Protection
    b. IP Adress Filtering
    c. HTTPS Encryption
    d. Digest Authentication
    e. User Access Log
16. Supported Protocols: IP{v4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ. FTP, CIFS/SMB, SMTP, Bonjour, UPnP, SNMPV1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
17. Operating Temperature: -4° to 122°F (-20° to 50°C)
18. Operating Humidity: 10% to 85%, noncondensing

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
B. Examine roughing-in for LAN, WAN, and IP network before device installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WIRING

A. Wiring Method: Install cables in raceways unless otherwise indicated.
   1. Except raceways are not required in accessible indoor ceiling spaces and attics.
   2. Except raceways are not required in hollow gypsum board partitions.
   3. Conceal raceways and wiring except in unfinished spaces.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

D. For LAN connection and fiber-optic and copper communication wiring, comply with Division 27 Sections "Communications Backbone Cabling" and "Communications Horizontal Cabling."

E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.03 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.

F. Avoid ground loops by making ground connections only at the control station.
   1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

G. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

H. Provide surge protection at each exterior mounted camera’s signal, control, and power input. Provide surge protection at each interior termination for all exterior camera signal, control and power cables.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Aa factory-authorized service representative shall 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. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
   2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
      a. Prepare equipment list described in "Submittals" Article.
      b. Verify operation of auto-iris lenses.

c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
e. Set and name all preset positions; consult and coordinate with Owner's personnel.
f. Set sensitivity of motion detection.
g. Set window blanking.
h. Connect and verify responses to alarms.
i. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

D. Video surveillance system will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.05 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.06 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.
B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.07 DEMONSTRATION

A. A factory-authorized service representative shall train the Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION

MISCELLANEOUS ELECTRICAL WORK – CONTINUED

Method of Measurement: Miscellaneous Electrical Work will be measured for payment on a lump sum basis. All plumbing-related work associated with the outbound Metra shelter building as shown on the plans and as described above shall be included for payment unless it is specifically included with a separate pay item.

Basis of Payment: This work will be paid for at the lump sum price for MISCELLANEOUS ELECTRICAL WORK.

MAINTENANCE OF ROADWAYS
Effective: September 30, 1985 Revised: November 1, 1996

Beginning on the date that work begins on this project, the Contractor shall assume responsibility for normal maintenance of all existing roadways within the limits of the improvement. This normal maintenance shall include all repair work deemed necessary by the Engineer, but shall not include snow removal operations. Traffic control and protection for maintenance of roadways will be provided by the Contractor as required by the Engineer.

If items of work have not been provided in the contract, or otherwise specified for payment, such items, including the accompanying traffic control and protection required by the Engineer, will be paid for in accordance with Article 109.04 of the Standard Specifications.

TRAFFIC CONTROL AND PROTECTION (ARTERIALS)
Effective: February 1, 1996
Revised: March 1, 2011

Specific traffic control plan details and Special Provisions have been prepared for this contract. This work shall include all labor, materials, transportation, handling and incidental work necessary to furnish, install, maintain and remove all traffic control devices required as indicated in the plans and as approved by the Engineer.

When traffic is to be directed over a detour route, the Contractor shall furnish, erect, maintain and remove all applicable traffic control devices along the detour route according to the details shown in the plans.

Method of Measurement: All traffic control (except Traffic Control and Protection (Expressways)) and temporary pavement markings) indicated on the traffic control plan details and specified in the Special Provisions will be measured for payment on a lump sum basis.

Basis of Payment: All traffic control and protection will be paid for at the contract lump sum price for TRAFFIC CONTROL AND PROTECTION (SPECIAL).

Temporary pavement markings will be paid for separately unless shown on a Standard.

TRAFFIC CONTROL PLAN
Effective: September 30, 1985
Revised: January 1, 2007

Traffic Control shall be according to the applicable sections of the Standard Specifications, the Supplemental Specifications, the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways", any special details and Highway Standards contained in the plans, and the Special Provisions contained herein.

Special attention is called to Article 107.09 of the Standard Specifications and the following Highway Standards, Details, Quality Standard for Work Zone Traffic Control Devices, Recurring Special Provisions and Special Provisions contained herein, relating to traffic control.

The Contractor shall contact the District One Bureau of Traffic at least 72 hours in advance of beginning work.

STANDARDS:

701001-02 Off-Road Operations, 2L, 2W, More Than 15' (4.5M) Away
701006-05 Off-Road Operations, 2L, 2W, 15' (4.5M) to 24" (600MM) From Pavement Edge
701301-04 Lane Closure, 2L, 2W, Short Time Operations
701311-03 Lane Closure, 2L, 2W, Moving Operations – Day Only
701501-06 Urban Lane Closure, 2L, 2W, Undivided
701606-10 Urban Single Lane Closure, Multilane, 2-Way with Mountable Median
701701-10 Urban Lane Closure, Multilane Intersection
701801-06 Sidewalk Corner or Crosswalk Closure
701901-08 Traffic Control Devices

DETAILS:

TC-10 – Traffic Control and Protection for Side Roads, Intersections and Driveways
TC-13 – District One Typical Pavement Markings
TC-16 – Short Term Pavement Marking Letters and Symbols

SPECIAL PROVISIONS:

Maintenance of Roadways
Traffic Control and Protection (Arterials)
Public Convenience and Safety (Dist. 1)
Equipment Parking and Storage (BDE)
Temporary Pavement Marking (BDE)
Traffic Control Devices – Cones (BDE)
Work Zone Traffic Control Devices (BDE)

ADJUSTMENTS AND RECONSTRUCTIONS

Effective: March 15, 2011

Revise the first paragraph of Article 602.04 to read:

"**602.04 Concrete.** Cast-in-place concrete for structures shall be constructed of Class SI concrete according to the applicable portions of Section 503. Cast-in-place concrete for pavement patching around adjustments and reconstructions shall be constructed of Class PP-1 concrete, unless otherwise noted in the plans, according to the applicable portions of Section 1020."

Revise the third, fourth and fifth sentences of the second paragraph of Article 602.11(c) to read:

"Castings shall be set to the finished pavement elevation so that no subsequent adjustment will be necessary, and the space around the casting shall be filled with Class PP-1 concrete, unless otherwise noted in the plans, to the elevation of the surface of the base course or binder course. HMA surface or binder course material shall not be allowed. The pavement may be opened to traffic according to Article 701.17(e)(3)b."

Revise Article 603.05 to read:

"**603.05 Replacement of Existing Flexible Pavement.** After the castings have been adjusted, the surrounding space shall be filled with Class PP-1 concrete, unless otherwise noted in the plans, to the elevation of the surface of the base course or binder course. HMA surface or binder course material shall not be allowed. The pavement may be opened to traffic according to Article 701.17(e)(3)b."

Revise Article 603.06 to read:

"**603.06 Replacement of Existing Rigid Pavement.** After the castings have been adjusted, the pavement and HMA that was removed, shall be replaced with Class PP-1 concrete, unless otherwise noted in the plans, not less than 9 in. (225 mm) thick. The pavement may be opened to traffic according to Article 701.17(e)(3)b.

The surface of the Class PP concrete shall be constructed flush with the adjacent surface."

Revise the first sentence of Article 603.07 to read:

"**603.07 Protection Under Traffic.** After the casting has been adjusted and the Class PP concrete has been placed, the work shall be protected by a barricade and two lights according to Article 701.17(e)(3)b."

AGGREGATE SUBGRADE IMPROVEMENT (D-1)

Effective: February 22, 2012
Revised: April 1, 2016

Add the following Section to the Standard Specifications:

"**SECTION 303. AGGREGATE SUBGRADE IMPROVEMENT**

303.01 Description. This work shall consist of constructing an aggregate subgrade improvement.

303.02 Materials. Materials shall be according to the following.

Item	Article/Section
(a) Coarse Aggregate	1004.07
(b) Reclaimed Asphalt Pavement (RAP) (Notes 1, 2 and 3)	1031

Note 1. Crushed RAP, from either full depth or single lift removal, may be mechanically blended with aggregate gradation CS 01 but shall not exceed 40 percent by weight of the total product. The top size of the Coarse RAP shall be less than 4 in. (100 mm) and well graded.

Note 2. RAP having 100 percent passing the 1 1/2 in (37.5 mm) sieve and being well graded, may be used as capping aggregate in the top 3 in. (75 mm) when aggregate gradation CS 01 is used in lower lifts. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders. The final product shall not contain more than 40 percent by weight of RAP.

Note 3. The RAP used for aggregate subgrade improvement shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

303.03 Equipment. The vibratory machine shall be according to Article 1101.01, or as approved by the Engineer. The calibration for the mechanical feeders shall have an accuracy of ± 2.0 percent of the actual quantity of material delivered.

303.04 Soil Preparation. The stability of the soil shall be according to the Department's Subgrade Stability Manual for the aggregate thickness specified.

303.05 Placing Aggregate. The maximum nominal lift thickness of aggregate gradation CS 01 shall be 24 in. (600 mm).

303.06 Capping Aggregate. The top surface of the aggregate subgrade shall consist of a minimum 3 in. (75 mm) of aggregate gradations CA 06 or CA 10. When Reclaimed Asphalt Pavement (RAP) is used, it shall be crushed and screened where 100 percent is passing the 1 1/2 in. (37.5 mm) sieve and being well graded. RAP that has been fractionated to size will not be permitted for use in capping. Capping aggregate will not be required when the aggregate subgrade improvement is used as a cubic yard pay item for undercut applications. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders.

303.07 Compaction. All aggregate lifts shall be compacted to the satisfaction of the Engineer. If the moisture content of the material is such that compaction cannot be obtained, sufficient water shall be added so that satisfactory compaction can be obtained.

303.08 Finishing and Maintenance of Aggregate Subgrade Improvement. The aggregate subgrade improvement shall be finished to the lines, grades, and cross sections shown on the plans, or as directed by the Engineer. The aggregate subgrade improvement shall be maintained in a smooth and compacted condition.

303.09 Method of Measurement. This work will be measured for payment according to Article 311.08.

303.10 Basis of Payment. This work will be paid for at the contract unit price per cubic yard (cubic meter) for AGGREGATE SUBGRADE IMPROVEMENT or at the contract unit price per square yard (square meter) for AGGREGATE SUBGRADE IMPROVEMENT, of the thickness specified.

Add the following to Section 1004 of the Standard Specifications:

"**1004.07 Coarse Aggregate for Aggregate Subgrade Improvement.** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate shall be crushed gravel, crushed stone, or crushed concrete. The top 12 inches of the aggregate subgrade improvement shall be 3 inches of capping material and 9 inches of crushed gravel, crushed stone or crushed concrete. In applications where greater than 36 inches of subgrade material is required, rounded

gravel, meeting the CS01 gradation, may be used beginning at a depth of 12 inches below the bottom of pavement.

(b) Quality. The coarse aggregate shall consist of sound durable particles reasonably free of deleterious materials. Non-mechanically blended RAP may be allowed up to a maximum of 5.0 percent.

(c) Gradation.

(1) The coarse aggregate gradation for total subgrade thicknesses of 12 in. (300 mm) or greater shall be CS 01.

Grad No.	COARSE AGGREGATE SUBGRADE GRADATIONS Sieve Size and Percent Passing				
	8”	6”	4”	2”	#4
CS 01	100	97 ± 3	90 ± 10	45 ± 25	20 ± 20

Grad No.	COARSE AGGREGATE SUBGRADE GRADATIONS (Metric) Sieve Size and Percent Passing				
	200 mm	150 mm	100 mm	50 mm	4.75 mm
CS 01	100	97 ± 3	90 ± 10	45 ± 25	20 ± 20

(2) The 3 in. (75 mm) capping aggregate shall be gradation CA 6 or CA 10.

COARSE AGGREGATE FOR BACKFILL, TRENCH BACKFILL AND BEDDING (D-1)

Effective: November 1, 2011
Revised: November 1, 2013

This work shall be according to Section 1004.05 of the Standard Specifications except for the following:

Reclaimed Asphalt Pavement (RAP) maybe blended with gravel, crushed gravel, crushed stone crushed concrete, crushed slag, chats, crushed sand stone or wet bottom boiler slag. The RAP used shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, “Reclaimed Asphalt Pavement (RAP) for Aggregate Applications”. The RAP shall be uniformly graded and shall pass the 1.0 in. (25 mm) screen. When RAP is blended with any of the coarse aggregate listed above, the blending shall be done mechanically with calibrated feeders. The feeders shall have an accuracy of ± 2.0 percent of the actual quantity of material delivered. The final blended product shall not contain more than 40 percent by weight RAP.

The coarse aggregate listed above shall meet CA 6 and CA 10 gradations prior to being blended with the processed and uniformly graded RAP. Gradation deleterious count shall not exceed 10% of total RAP and 5% of other by total weight.

EMBANKMENT II

Effective: March 1, 2011
Revised: November 1, 2013

Description. This work shall be according to Section 205 of the Standard Specifications except for the following.

Material. Reclaimed asphalt shall not be used within the ground water table or as a fill if ground water is present. The RAP used shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications". Gradation deleterious count shall not exceed 10% of total RAP and 5% of other by total weight.

CONSTRUCTION REQUIREMENTS

Samples. Embankment material shall be sampled and tested before use. The contractor shall identify embankment sources, and provide equipment as the Engineer requires, for the collection of samples from those sources. Samples will be furnished to the Geotechnical Engineer a minimum of three weeks prior to use in order that laboratory tests for compaction can be performed. Embankment material placement cannot begin until tests are completed.

Placing Material. In addition to Article 202.03, broken concrete, reclaimed asphalt with no expansive aggregate, or uncontaminated dirt and sand generated from construction or demolition activities shall be placed in 6 inches (150 mm) lifts and disked with the underlying lift until a uniform homogenous material is formed. This process also applies to the overlaying lifts. The disk must have a minimum blade diameter of 24 inches (600 mm).

When embankments are to be constructed on hillsides or existing slopes that are steeper than 3H:1V, steps shall be keyed into the existing slope by stepping and benching as shown in the plans or as directed by the Engineer.

Compaction. Soils classification for moisture content control will be determined by the Soils Inspector using visual field examination techniques and the IDH Textural Classification Chart.

When tested for density in place each lift shall have a maximum moisture content as follows.

a) A maximum of 110 percent of the optimum moisture for all forms of clay soils.

b) A maximum of 105 percent of the optimum moisture for all forms of clay loam soils.

Stability. The requirement for embankment stability in article 205.04 will be measured with a Dynamic Cone Penetrometer (DCP) according to the test method in the IDOT Geotechnical Manual. The penetration rate must be equal or less than 1.5 inches (38 mm) per blow.

Basis of Payment. This work will not be paid separately but will be considered as included in the various items of excavation.

FRICTION AGGREGATE (D-1)

Effective: January 1, 2011
Revised: November 1, 2019

Revise Article 1004.03(a) of the Standard Specifications to read:

"**1004.03 Coarse Aggregate for Hot-Mix Asphalt (HMA).** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate for HMA shall be according to the following table.

Use	Mixture	Aggregates Allowed
Class A	Seal or Cover	Allowed Alone or in Combination [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete
HMA Low ESAL	Stabilized Subbase or Shoulders	Allowed Alone or in Combination [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[1/] Crushed Concrete
HMA High ESAL Low ESAL	Binder IL-19.0 or IL-19.0L SMA Binder	Allowed Alone or in Combination [5/ 6/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Concrete[3/]

<table>
<tr><th>Use</th><th>Mixture</th><th>Aggregates Allowed</th></tr>
<tr><td>HMA
High ESAL
Low ESAL</td><td>C Surface and Binder IL-9.5 or IL-9.5L

SMA
Ndesign 50
Surface</td><td><u>Allowed Alone or in Combination</u> [5/]:

Crushed Gravel
Carbonate Crushed Stone[2/]
Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag[4/]
Crushed Concrete[3/]</td></tr>
<tr><td rowspan="5">HMA
High ESAL</td><td rowspan="5">D Surface and Binder IL-9.5

SMA
Ndesign 50
Surface</td><td><u>Allowed Alone or in Combination</u> [5/]:

Crushed Gravel
Carbonate Crushed Stone (other than Limestone)[2/]
Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag[4/]
Crushed Concrete[3/]</td></tr>
<tr><td><u>Other Combinations Allowed:</u>

Up to... | With...</td></tr>
<tr><td>25% Limestone | Dolomite</td></tr>
<tr><td>50% Limestone | Any Mixture D aggregate other than Dolomite</td></tr>
<tr><td>75% Limestone | Crushed Slag (ACBF) or Crushed Sandstone</td></tr>
<tr><td rowspan="4">HMA
High ESAL</td><td rowspan="4">E Surface
IL-9.5

SMA
Ndesign 80
Surface</td><td><u>Allowed Alone or in Combination</u> [5/ 6/]:

Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag

No Limestone.</td></tr>
<tr><td><u>Other Combinations Allowed:</u>

Up to... | With...</td></tr>
<tr><td>50% Dolomite[2/] | Any Mixture E aggregate</td></tr>
</table>

<table>
<tr><td>Use</td><td>Mixture</td><td colspan="2">Aggregates Allowed</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>75% Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
<tr><td>75% Crushed Gravel[2/] or Crushed Concrete[3/]</td><td>Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF), or Crushed Steel Slag</td></tr>
<tr><td rowspan="4">HMA
High ESAL</td><td rowspan="4">F Surface
IL-9.5

SMA
Ndesign 80
Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/ 6/]:

Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag
No Limestone.</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed</u>:</td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Crushed Gravel[2/], Crushed Concrete[3/], or Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
</table>

1/ Crushed steel slag allowed in shoulder surface only.
2/ Carbonate crushed stone (limestone) and/or crushed gravel shall not be used in SMA Ndesign 80. In SMA Ndesign 50, carbonate crushed stone shall not be blended with any of the other aggregates allowed alone in Ndesign 50 SMA binder or Ndesign 50 SMA surface.
3/ Crushed concrete will not be permitted in SMA mixes.
4/ Crushed steel slag shall not be used as leveling binder.
5/ When combinations of aggregates are used, the blend percent measurements shall be by volume."
6/ Combining different types of aggregate will not be permitted in SMA Ndesign 80."

GROUND TIRE RUBBER (GTR) MODIFIED ASPHALT BINDER (D-1)

Effective: June 26, 2006
Revised: April 1, 2016

Add the following to the end of article 1032.05 of the Standard Specifications:

"(c) Ground Tire Rubber (GTR) Modified Asphalt Binder. A quantity of 10.0 to 14.0 percent GTR (Note 1) shall be blended by dry unit weight with a PG 64-28 to make a GTR 70-28 or a PG 58-28 to make a GTR 64-28. The base PG 64-28 and PG 58-28 asphalt binders shall meet the requirements of Article 1032.05(a). Compatible polymers may be added during production. The GTR modified asphalt binder shall meet the requirements of the following table.

Test	Asphalt Grade GTR 70-28	Asphalt Grade GTR 64-28
Flash Point (C.O.C.), AASHTO T 48, °F (°C), min.	450 (232)	450 (232)
Rotational Viscosity, AASHTO T 316 @ 275 °F (135 °C), Poises, Pa·s, max.	30 (3)	30 (3)
Softening Point, AASHTO T 53, °F (°C), min.	135 (57)	130 (54)
Elastic Recovery, ASTM D 6084, Procedure A (sieve waived) @ 77 °F, (25 °C), aged, ss, 100 mm elongation, 5 cm/min., cut immediately, %, min.	65	65

Note 1. GTR shall be produced from processing automobile and/or light truck tires by the ambient grinding method. GTR shall not exceed 1/16 in. (2 mm) in any dimension and shall contain no free metal particles or other materials. A mineral powder (such as talc) meeting the requirements of AASHTO M 17 may be added, up to a maximum of four percent by weight of GTR to reduce sticking and caking of the GTR particles. When tested in accordance with Illinois modified AASHTO T 27, *a* 50 g sample of the GTR shall conform to the following gradation requirements:

Sieve Size	Percent Passing
No. 16 (1.18 mm)	100
No. 30 (600 µm)	95 ± 5
No. 50 (300 µm)	> 20

Add the following to the end of Note 1. of article 1030.03 of the Standard Specifications:

"A dedicated storage tank for the Ground Tire Rubber (GTR) modified asphalt binder shall be provided. This tank must be capable of providing continuous mechanical mixing throughout by continuous agitation and recirculation of the asphalt binder to provide a uniform mixture. The tank shall be heated and capable of maintaining the temperature of the asphalt binder at 300 °F to 350 °F (149 °C to 177 °C). The asphalt binder metering systems of dryer drum plants shall be calibrated with the actual GTR modified asphalt binder material with an accuracy of ± 0.40 percent."

Revise 1030.02(c) of the Standard Specifications to read:

"(c) RAP Materials (Note 5) ……..…..1031"

Add the following note to 1030.02 of the Standard Specifications:

Note 5. When using reclaimed asphalt pavement and/or reclaimed asphalt shingles, the maximum asphalt binder replacement percentage shall be according to the most recent special provision for recycled materials.

HOT-MIX ASPHALT BINDER AND SURFACE COURSE (D-1)

Effective: November 1, 2019
Revised: February 2, 2020

Description. This work shall consist of constructing a hot-mix asphalt (HMA) binder and/or surface course on a prepared base. Work shall be according to Sections 406 and 1030 of the Standard Specifications, except as modified herein.

Materials. Revise Article 1004.03(c) to read:

" (c) Gradation. The coarse aggregate gradations shall be as listed in the following table.

Use	Size/Application	Gradation No.
Class A-1, A-2, & A-3	3/8 in. (10 mm) Seal	CA 16 or CA 20
Class A-1	1/2 in. (13 mm) Seal	CA 15
Class A-2 & A-3	Cover Coat	CA 14
HMA High ESAL	IL-19.0; Stabilized Subbase IL-19.0	CA 11 1/
	SMA 12.5 2/	CA 13 4/, CA 14, or CA 16
	SMA 9.5 2/	CA 13 3/4/ or CA 16 3/
	IL-9.5	CA 16, CM 13 4/
	IL-9.5FG	CA 16
HMA Low ESAL	IL-19.0L	CA 11 1/
	IL-9.5L	CA 16

1/ CA 16 or CA 13 may be blended with the CA 11.

2/ The coarse aggregates used shall be capable of being combined with stone sand, slag sand, or steel slag sand meeting the FA/FM 20 gradation and mineral filler to meet the approved mix design and the mix requirements noted herein.

3/ The specified coarse aggregate gradations may be blended.

4/ CA 13 shall be 100 percent passing the 1/2 in. (12.5mm) sieve."

Revise Article 1004.03(e) of the Supplemental Specifications to read:

"(e) Absorption. For SMA the coarse aggregate shall also have water absorption ≤ 2.0 percent."

HMA Nomenclature. Revise the "High ESAL" portion of the table in Article 1030.01 to read:

"High ESAL	Binder Courses	IL-19.0, IL-9.5, IL-9.5FG, IL-4.75, SMA 12.5, Stabilized Subbase IL-19.0
	Surface Courses	IL-9.5, IL-9.5FG, SMA 12.5, SMA 9.5"

Revise Article 1030.02 of the Standard Specifications and Supplemental Specifications to read:

"**1030.02 Materials.** Materials shall be according to the following.

Item	Article/Section
(a) Coarse Aggregate	1004.03
(b) Fine Aggregate	1003.03
(c) RAP Material	1031
(d) Mineral Filler	1011
(e) Hydrated Lime	1012.01
(f) Slaked Quicklime (Note 1)	
(g) Performance Graded Asphalt Binder (Note 2)	1032
(h) Fibers (Note 3)	
(i) Warm Mix Asphalt (WMA) Technologies (Note 4)	

Note 1. Slaked quicklime shall be according to ASTM C 5.

Note 2. The asphalt binder shall be an SBS PG 76-28 when the SMA is used on a full-depth asphalt pavement and SBS PG 76-22 when used as an overlay, except where modified herein. The asphalt binder shall be a SBS PG 76-22 for IL-4.75, except where modified herein. The elastic recovery shall be a minimum of 80.

Note 3. A stabilizing additive such as cellulose or mineral fiber shall be added to the SMA mixture according to Illinois Modified AASHTO M 325. The stabilizing additive shall meet the Fiber Quality Requirements listed in Illinois Modified AASHTO M 325. Prior to approval and use of fibers, the Contractor shall submit a notarized certification by the producer of these materials stating they meet these requirements. Reclaimed Asphalt Shingles (RAS) may be used in Stone Matrix Asphalt (SMA) mixtures designed with an SBA polymer modifier as a fiber additive if the mix design with RAS included meets AASHTO T305 requirements. The RAS shall be from a certified source that produces either Type I or Type 2. Material shall meet requirements noted herein and the actual dosage rate will be determined by the Engineer.

Note 4. Warm mix additives or foaming processes shall be selected from the Department's Qualified Producer List, "Technologies for the Production of Warm Mix Asphalt (WMA)"."

Mixture Design. Revise Article 1030.04(a)(1) of the Standard Specifications and the Supplemental Specifications to read:

High ESAL, MIXTURE COMPOSITION (% PASSING) [1/]										
Sieve Size	IL-19.0 mm		SMA 12.5		SMA 9.5		IL-9.5mm		IL-4.75 mm	
	min	max	min	max	min	max	min	max	min	max
1 1/2 in (37.5 mm)										
1 in. (25 mm)		100								
3/4 in. (19 mm)	90	100		100						
1/2 in. (12.5 mm)	75	89	80	100		100		100		100
3/8 in. (9.5 mm)				65	90	100	90	100		100
#4 (4.75 mm)	40	60	20	30	36	50	34	69	90	100
#8 (2.36 mm)	20	42	16	24 [4/]	16	32[4/]	34 [5/]	52 [2/]	70	90
#16 (1.18 mm)	15	30					10	32	50	65
#30 (600 μm)			12	16	12	18				
#50 (300 μm)	6	15					4	15	15	30
#100 (150 μm)	4	9					3	10	10	18
#200 (75 μm)	3	6	7.0	9.0 [3/]	7.5	9.5 [3/]	4	6	7	9 [3/]
#635 (20 μm)			≤ 3.0		≤ 3.0					
Ratio Dust/Asphalt Binder		1.0		1.5		1.5		1.0		1.0

1/ Based on percent of total aggregate weight.

2/ The mixture composition shall not exceed 44 percent passing the #8 (2.36 mm) sieve for surface courses with Ndesign = 90.

3/ Additional minus No. 200 (0.075 mm) material required by the mix design shall be mineral filler, unless otherwise approved by the Engineer.

4/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted above the percentage stated on the table.

5/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted below 34 percent.

Revise Article 1030.04(b)(1) of the Standard Specifications to read:

"(1) High ESAL Mixtures. The target value for the air voids of the HMA shall be 4.0 percent, for IL-4.75 it shall be 3.5 percent and for Stabilized Subbase it shall be 3.0 percent at the design number of gyrations. The voids in the mineral aggregate (VMA) and voids filled with asphalt binder (VFA) of the HMA design shall be based on the nominal maximum size of the aggregate in the mix and shall conform to the following requirements.

VOLUMETRIC REQUIREMENTS High ESAL				
	Voids in the Mineral Aggregate (VMA), % minimum			Voids Filled with Asphalt Binder (VFA), %
Ndesign	IL-19.0; Stabilized Subbase IL- 19.0	IL-9.5	IL-4.75 1/	
50	13.5	15.0	18.5	65 – 78 2/
70				65 - 75
90				

1/ Maximum draindown for IL-4.75 shall be 0.3 percent.

2/ VFA for IL-4.75 shall be 72-85 percent."

Revise the table in Article 1030.04(b)(3) to read:

"VOLUMETRIC REQUIREMENTS, SMA 12.5 1/ and SMA 9.5 1/			
Ndesign	Design Air Voids Target %	Voids in the Mineral Aggregate (VMA), % min.	Voids Filled with Asphalt (VFA), %
80 4/	3.5	17.0 2/	75 - 83
		16.0 3/	

1/ Maximum draindown shall be 0.3 percent. The draindown shall be determined at the JMF asphalt binder content at the mixing temperature plus 30 °F.

2/ Applies when specific gravity of coarse aggregate is ≥ 2.760.

3/ Applies when specific gravity of coarse aggregate is < 2.760.

4/ Blending of different types of aggregate will not be permitted. For surface course, the coarse aggregate can be crushed steel slag, crystalline crushed stone or crushed sandstone. For binder course, coarse aggregate shall be crushed stone (dolomite), crushed gravel, crystalline crushed stone, or crushed sandstone.

Add to the end of Article 1030.05 (d) (2) a. of the Standard Specifications:

"During production, the Contractor shall test SMA mixtures for draindown according to AASHTO T305 at a frequency of 1 per day of production."

Revise the last paragraph of Article 1102.01 (a) (5) of the Standard Specifications to read:

"IL-4.75 and Stone Matrix Asphalt (SMA) mixtures which contain aggregate having absorptions greater than or equal to 2.0 percent, or which contain steal slag sand, shall have minimum surge bin storage plus haul time of 1.5 hours."

Quality Control/Quality Assurance (QC/QA). Revise the third paragraph of Article 1030.05(d)(3) to read:

"If the Contractor and Engineer agree the nuclear density test method is not appropriate for the mixture, cores shall be taken at random locations determined according to the QC/QA document "Determination of Random Density Test Site Locations". Core densities shall be determined using the Illinois Modified AASHTO T 166 or T 275 procedure."

Add the following paragraphs to the end of Article 1030.05(d)(3):

"Longitudinal joint density testing shall be performed at each random density test location. Longitudinal joint testing shall be located at a distance equal to the lift thickness or a minimum of 4 in. (100 mm), from each pavement edge (i.e. for a 5 in. (125 mm) lift the near edge of the density gauge or core barrel shall be within 5 in. (125 mm) from the edge of pavement). Longitudinal joint density testing shall be performed using either a correlated nuclear gauge or cores.

a. Confined Edge. Each confined edge density shall be represented by a one-minute nuclear density reading or a core density and shall be included in the average of density readings or core densities taken across the mat which represents the Individual Test.

b. Unconfined Edge. Each unconfined edge joint density shall be represented by an average of three one-minute density readings or a single core density at the given density test location and shall meet the density requirements specified herein. The three one-minute readings shall be spaced 10 ft (3 m) apart longitudinally along the unconfined pavement edge and centered at the random density test location.

When a longitudinal joint sealant (LJS) is applied, longitudinal joint density testing will not be required on the joint(s) sealed."

Revise the second table in Article 1030.05(d)(4) and its notes to read:

"DENSITY CONTROL LIMITS			
Mixture Composition	Parameter	Individual Test (includes confined edges)	Unconfined Edge Joint Density, minimum
IL-4.75	Ndesign = 50	93.0 – 97.4 % 1/	91.0%
IL-9.5FG	Ndesign = 50 - 90	93.0 – 97.4 %	91.0%
IL-9.5	Ndesign = 90	92.0 – 96.0 %	90.0%
IL-9.5, IL-9.5L,	Ndesign < 90	92.5 – 97.4 %	90.0%
IL-19.0	Ndesign = 90	93.0 – 96.0 %	90.0%
IL-19.0, IL-19.0L	Ndesign < 90	93.0 2/ – 97.4 %	90.0%
SMA	Ndesign = 80	93.5 – 97.4 %	91.0%

1/ Density shall be determined by cores or by correlated, approved thin lift nuclear gauge.

2/ 92.0 % when placed as first lift on an unimproved subgrade."

Equipment. Add the following to Article 1101.01 of the Standard Specifications:

"(h) Oscillatory Roller. The oscillatory roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The oscillatory roller shall be able to operate in a mode that will provide tangential impact force with or without vertical impact force by using at least one drum. The oscillatory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the drums to prevent material pickup. The drum(s) amplitude and frequency of the tangential and vertical impact force shall be approximately the same in each direction and meet the following requirements:

(1) The minimum diameter of the drum(s) shall be 42 in. (1070 mm);

(2) The minimum length of the drum(s) shall be 57 in. (1480 mm);

(3) The minimum unit static force on the drum(s) shall be 125 lb/in. (22 N/m); and

(4) The minimum force on the oscillatory drum shall be 18,000 lb (80 kN)."

Construction Requirements.

Add the following to Article 406.03 of the Standard Specifications:

"(j) Oscillatory Roller .....1101.01"

Revise the third paragraph of Article 406.05(a) to read:

"All depressions of 1 in. (25 mm) or more in the surface of the existing pavement shall be filled with binder. At locations where heavy disintegration and deep spalling exists, the area shall be cleaned of all loose and unsound material, tacked, and filled with binder (hand method)."

Revise Article 406.05(c) to read.

"(c) Binder (Hand Method). Binder placed other than with a finishing machine will be designated as binder (hand method) and shall be compacted with a roller to the satisfaction of the Engineer. Hand tamping will be permitted when approved by the Engineer."

Revise the special conditions for mixture IL-4.75 in Article 406.06(b)(2)e. to read:

"e. The mixture shall be overlaid within 5 days of being placed."

Revise Article 406.06(d) to read:

"(d) Lift Thickness. The minimum compacted lift thickness for HMA binder and surface courses shall be as follows.

MINIMUM COMPACTED LIFT THICKNESS	
Mixture Composition	Thickness, in. (mm)
IL-4.75	3/4 (19) - over HMA surfaces 1/ 1 (25) - over PCC surfaces 1/
IL-9.5FG	1 1/4 (32)
IL-9.5, IL-9.5L	1 1/2 (38)
SMA 9.5	1 3/4 (45)
SMA 12.5	2 (51)
IL-19.0, IL-19.0L	2 1/4 (57)

1/ The maximum compacted lift thickness for mixture IL-4.75 shall be 1 1/4 in. (32 mm)."

Revise Table 1 and Note 3/ of Table 1 in Article 406.07(a) of the Standard Specifications to read:

"TABLE 1 - MINIMUM ROLLER REQUIREMENTS FOR HMA				
	Breakdown Roller (one of the following)	Intermediate Roller	Final Roller (one or more of the following)	Density Requirement
Binder and Surface 1/	V_D, P 3/, T_B, 3W, O_T, O_B	P 3/, O_T, O_B	V_S, T_B, T_F, O_T	As specified in Articles:

				1030.05(d)(3), (d)(4), and (d)(7).
IL-4.75 and SMA [4/ 5/]	T_B, 3W, O_T	- -	T_F, 3W, O_T	
Bridge Decks [2/]	T_B	- -	T_F	As specified in Articles 582.05 and 582.06.

3/ A vibratory roller (V_D) or oscillatory roller (O_T or O_B) may be used in lieu of the pneumatic-tired roller on mixtures containing polymer modified asphalt binder."

Add the following to EQUIPMENT DEFINITION in Article 406.07(a) contained in the Errata of the Supplemental Specifications:

"O_T - Oscillatory roller, tangential impact mode. Maximum speed is 3.0 mph (4.8 km/h) or 264 ft/min (80 m/min).

O_B - Oscillatory roller, tangential and vertical impact mode, operated at a speed to produce not less than 10 vertical impacts/ft (30 impacts/m)."

Delete last sentence of the second paragraph of Article 1102.01(a) (4) b. 2.

Add to the end of Article 1102.01 (a) (4) b. 2.:

"As an option, collected dust (baghouse) may be used in lieu of manufactured mineral filler according to the following:

(a.) Sufficient collected dust (baghouse) is available for production of the SMA mix for the entire project.

(b.) A mix design was prepared based on collected dust (baghouse).

Revise Article 1030.04 (d) of the Standard Specifications to read:

"(d) Verification Testing. High ESAL, IL-4.75, and SMA mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the Hamburg Wheel Test (IL mod AASHTO T-324) and the Tensile Strength Test (IL mod AASHTO T-283). The Department will perform a verification test on gyratory specimens compacted by the Contractor. If the mix fails the Department's verification test, the Contractor shall make the necessary changes to the mix and resubmit compacted specimens to the Department for verification. If the mix fails again, the mix design will be rejected.

All new mix designs will be required to be tested, prior to submittal for Department verification and shall meet the following requirements:

(1)Hamburg Wheel Test criteria. The maximum allowable rut depth shall be 0.5 in. (12.5 mm). The minimum number of wheel passes at the 0.5 in. (12.5 mm) rut

depth criteria shall be based on the high temperature binder grade of the mix as specified in the mix requirements table of the plans.

Illinois Modified AASHTO T 324 Requirements [1/]

Asphalt Binder Grade	# Repetitions	Max Rut Depth (mm)
PG 70 -XX (or higher)	20,000	12.5
PG 64 -XX (or lower)	10,000	12.5

1/ When produced at temperatures of 275 ± 5 °F (135 ± 3 °C) or less, loose Warm Mix Asphalt shall be oven aged at 270 ± 5 °F (132 ± 3 °C) for two hours prior to gyratory compaction of Hamburg Wheel specimens.

Note: For SMA Designs (N-80) the maximum rut depth is 6.0 mm at 20,000 repetitions.
For IL 4.75mm Designs (N-50) the maximum rut depth is 9.0mm at 15,000 repetitions.

(2) Tensile Strength Criteria. The minimum allowable conditioned tensile strength shall be 60 psi (415 kPa) for non-polymer modified performance graded (PG) asphalt binder and 80 psi (550 kPa) for polymer modified PG asphalt binder. The maximum allowable unconditioned tensile strength shall be 200 psi (1380 kPa)."

Production Testing. Revise first paragraph of Article 1030.06(a) of the Standard Specifications to read:

"(a) High ESAL, IL-4.75, WMA, and SMA Mixtures. For each contract, a 300 ton (275 metric tons) test strip, except for SMA mixtures it will be 400 ton (363 metric ton), will be required at the beginning of HMA production for each mixture at the beginning of each construction year according to the Manual of Test Procedures for Materials "Hot Mix Asphalt Test Strip Procedures". At the request of the Producer, the Engineer may waive the test strip if previous construction during the current construction year has demonstrated the constructability of the mix using Department test results."

Add the following after the sixth paragraph in Article 1030.06 (a) of the Standard Specifications:

"The Hamburg Wheel test shall also be conducted on all HMA mixtures from a sample taken within the first 500 tons (450 metric tons) on the first day of production or during start up with a split reserved for the Department. The mix sample shall be tested according to the Illinois Modified AASHTO T 324 and shall meet the requirements specified herein. Mix production shall not exceed 1500 tons (1350 metric tons) or one day's production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the plant produced mixture demonstrates conformance prior to start of mix production for a contract.
If the mixture fails to meet the Hamburg Wheel criteria, no further mixture will be accepted until the Contractor takes such action as is necessary to furnish a mixture meeting the criteria"

Method of Measurement:

Add the following after the fourth paragraph of Article 406.13 (b):

"The plan quantities of SMA mixtures shall be adjusted using the actual approved binder and surface Mix Design's G_{mb}."

Basis of Payment. Replace the second through the fifth paragraphs of Article 406.14 with the following:

"HMA binder and surface courses will be paid for at the contract unit price per ton (metric ton) for MIXTURE FOR CRACKS, JOINTS, AND FLANGEWAYS; HOT-MIX ASPHALT BINDER COURSE (HAND METHOD), of the Ndesign specified; HOT-MIX ASPHALT BINDER COURSE, of the mixture composition and Ndesign specified; HOT-MIX ASPHALT SURFACE COURSE, of the mixture composition, friction aggregate, and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE (HAND METHOD), of the Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE, of the mixture composition and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, of the mixture composition, friction aggregate, and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE, STONE MATRIX ASPHALT, of the mixture composition and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, STONE MATRIX ASPHALT, of the mixture composition, friction aggregate, and Ndesign specified."

PUBLIC CONVIENENCE AND SAFETY (DIST 1)
Effective: May 1, 2012
Revised: July 15, 2012

Add the following to the end of the fourth paragraph of Article 107.09:

> "If the holiday is on a Saturday or Sunday, and is legally observed on a Friday or Monday, the length of Holiday Period for Monday or Friday shall apply."

Add the following sentence after the Holiday Period table in the fourth paragraph of Article 107.09:

> "The Length of Holiday Period for Thanksgiving shall be from 5:00 AM the Wednesday prior to 11:59 PM the Sunday After"

Delete the fifth paragraph of Article 107.09 of the Standard Specifications:

> "On weekends, excluding holidays, roadways with Average Daily Traffic of 25,000 or greater, all lanes shall be open to traffic from 3:00 P.M. Friday to midnight Sunday except where structure construction or major rehabilitation makes it impractical."

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1)

Effective: November 1, 2012
Revise: November 1, 2019

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

1031.01 Description. Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material resulting from cold milling or crushing an existing hot-mix asphalt (HMA) pavement. RAP will be considered processed FRAP after completion of both crushing and screening to size. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Central Bureau of Materials approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 90 percent passing the #4 (4.75 mm) sieve. RAS shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1031.02 Stockpiles. RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. Additional processed RAP (FRAP) shall be stockpiled in a separate working pile, as designated in the QC Plan, and only added to the sealed stockpile when test results for the working pile are complete and are found to meet tolerances specified herein for the original sealed FRAP stockpile. Stockpiles shall be sufficiently separated to prevent intermingling at the base. All stockpiles (including unprocessed RAP and FRAP) shall be identified by signs indicating the type as listed below (i.e. "Non- Quality, FRAP -#4 or Type 2 RAS", etc…).

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. All FRAP shall be processed prior to testing and sized into fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the

RAP in the coarse fraction shall pass the maximum sieve size specified for the mixture composition of the mix design.

(2) Restricted FRAP (B quality) stockpiles shall consist of RAP from Class I, HMA (High ESAL), or HMA (High ESAL). If approved by the Engineer, the aggregate from a maximum 3.0 in. (75 mm) single combined pass of surface/binder milling will be classified as B quality. All millings from this application will be processed into FRAP as described previously.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed (FRAP) prior to testing. Conglomerate RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(4) Conglomerate “D” Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from HMA shoulders, bituminous stabilized subbases or HMA (Low ESAL)/HMA (Low ESAL) IL-19.0L binder mixture. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as “Non-Quality”.

RAP or FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, plant cleanout etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall be sufficiently separated to prevent intermingling at the base. Each stockpile shall be signed indicating what type of RAS is present.

However, a RAS source may submit a written request to the Department for approval to blend mechanically a specified ratio of Type 1 RAS with Type 2 RAS. The source will not be permitted to change the ratio of the blend without the Department prior written approval. The Engineer’s written approval will be required, to mechanically blend RAS with any fine aggregate produced under the AGCS, up to an equal weight of RAS, to improve workability. The fine aggregate shall be “B Quality” or better from an approved Aggregate Gradation Control System source. The fine aggregate shall be one that is approved for use in the HMA mixture and accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type, and lot number shall be maintained by project contract number and kept for a minimum of three years.

1031.03 Testing. FRAP and RAS testing shall be according to the following.

(a) FRAP Testing. When used in HMA, the FRAP shall be sampled and tested either during processing or after stockpiling. It shall also be sampled during HMA production.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) Incoming Material. For testing as incoming material, washed extraction samples shall be run at a minimum frequency of one sample per 2000 tons (1800 metric tons) or once per week, whichever comes first.

(3) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Before extraction, each field sample of FRAP, shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS shall be sampled and tested during stockpiling according to Central Bureau of Materials Policy Memorandum, “Reclaimed Asphalt Shingle (RAS) Sources”. The Contractor shall also sample as incoming material at the HMA plant.

(1) During Stockpiling. Washed extraction and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 1000 tons (900 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS shall be in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

(2) Incoming Material. For testing as incoming material at the HMA plant, washed extraction shall be run at the minimum frequency of one sample per 250 tons (227 metric tons). A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). The incoming material test results shall meet the tolerances specified herein.

The Contractor shall obtain and make available all test results from start of the initial stockpile sampled and tested at the shingle processing facility in accordance with the facility’s QC Plan.

Before extraction, each field sample shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

1031.04 Evaluation of Tests. Evaluation of test results shall be according to the following.

(a) Evaluation of FRAP Test Results. All test results shall be compiled to include asphalt binder content, gradation and, when applicable (for slag), G_{mm}. A five test average of results from the original pile will be used in the mix designs. Individual extraction test results run thereafter, shall be compared to the average used for the mix design, and will be accepted if within the tolerances listed below.

Parameter	FRAP
No. 4 (4.75 mm)	± 6 %
No. 8 (2.36 mm)	± 5 %
No. 30 (600 μm)	± 5 %
No. 200 (75 μm)	± 2.0 %
Asphalt Binder	± 0.3 %
G_{mm}	± 0.03 1/

1/ For stockpile with slag or steel slag present as determined in the current Manual of Test Procedures Appendix B 21, “Determination of Reclaimed Asphalt Pavement Aggregate Bulk Specific Gravity”.

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the FRAP stockpile shall not be used in Hot-Mix Asphalt unless the FRAP representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

The Contractor shall maintain a representative moving average of five tests to be used for Hot-Mix Asphalt production.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the ITP, “Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)” or Illinois Modified AASHTO T-164-11, Test Method A.

(b) Evaluation of RAS Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. A five test average of results from the original pile will be used in the mix designs. Individual test results run thereafter, when compared to the average used for the mix design, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5 %

No. 16 (1.18 mm)	± 5 %
No. 30 (600 µm)	± 4 %
No. 200 (75 µm)	± 2.5 %
Asphalt Binder Content	± 2.0 %

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the RAS shall not be used in Hot-Mix Asphalt unless the RAS representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

(c) Quality Assurance by the Engineer. The Engineer may witness the sampling and splitting conduct assurance tests on split samples taken by the Contractor for quality control testing a minimum of once a month.

The overall testing frequency will be performed over the entire range of Contractor samples for asphalt binder content and gradation. The Engineer may select any or all split samples for assurance testing. The test results will be made available to the Contractor as soon as they become available.

The Engineer will notify the Contractor of observed deficiencies.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits.

Test Parameter	Acceptable Limits of Precision	
% Passing:[1/]	FRAP	RAS
1/2 in.	5.0%	
No. 4	5.0%	
No. 8	3.0%	4.0%
No. 30	2.0%	4.0%
No. 200	2.2%	4.0%
Asphalt Binder Content	0.3%	3.0%
G_{mm}	0.030	

1/ Based on washed extraction.

In the event comparisons are outside the above acceptable limits of precision, the Engineer will immediately investigate.

(d) Acceptance by the Engineer. Acceptable of the material will be based on the validation of the Contractor's quality control by the assurance process.

1031.05 Quality Designation of Aggregate in RAP and FRAP.

(a) RAP. The aggregate quality of the RAP for homogeneous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Fractionated RAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant laboratory prequalified by the Department for the specified testing. The consultant laboratory shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the Central Bureau of Materials Aggregate Lab for MicroDeval Testing, according to ITP 327. A maximum loss of 15.0 percent will be applied for all HMA applications. The fine aggregate portion of the fractionated RAP shall not be used in any HMA mixtures that require a minimum of “B” quality aggregate or better, until the coarse aggregate fraction has been determined to be acceptable thru a MicroDeval Testing.

1031.06 Use of FRAP and/or RAS in HMA. The use of FRAP and/or RAS shall be the Contractor’s option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(c) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0 percent by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts listed below for a given N Design.

Maximum Asphalt Binder Replacement (ABR) for FRAP with RAS Combination

HMA Mixtures 1/ 2/ 4/	Maximum % ABR		
Ndesign	Binder 5/	Surface 5/	Polymer Modified 3/
30L	50	40	30
50	40	35	30
70	40	30	30
90	40	30	30
SMA			30
IL-4.75			40

1/ For Low ESAL HMA shoulder and stabilized subbase, the percent asphalt binder replacement shall not exceed 50 % of the total asphalt binder in the mixture.

2/ When the binder replacement exceeds 15 % for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 % binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 %, the required virgin asphalt binder grade shall be PG64-28.

3/ When the ABR for SMA or IL-4.75 is 15 % or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds

15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

4/ When FRAP or RAS is used alone, the maximum percent asphalt binder replacement designated on the table shall be reduced by 10 %.

5/ When the mix has Illinois Flexibility Index Test (I-FIT) requirements, the maximum percent asphalt binder replacement designated on the table may be increased by 5%.

1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing FRAP and/or RAS material meeting the detailed requirements specified herein.

(a) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design.

The RAP, FRAP and RAS stone specific gravities (G_{sb}) shall be according to the "Determination of Aggregate Bulk (Dry) Specific Gravity (G_{sb}) of Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS)" procedure in the Department's Manual of Test Procedures for Materials.

1031.08 HMA Production. HMA production utilizing FRAP and/or RAS shall be as follows.

A scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAS and FRAP feed system to remove or reduce oversized and agglomerated material.

If during mix production, corrective actions fail to maintain FRAP, RAS or QC/QA test results within control tolerances or the requirements listed herein, the Contractor shall cease production of the mixture containing FRAP or RAS and conduct an investigation that may require a new mix design.

(a) FRAP. The coarse aggregate in all FRAP used shall be equal to or less than the nominal maximum size requirement for the HMA mixture being produced.

(b) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

(c) HMA Plant Requirements. HMA plants utilizing FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAS and FRAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate RAS and FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS and FRAP are printed in wet condition.)

i. When producing mixtures with FRAP and/or RAS, a positive dust control system shall be utilized.

j. Accumulated mixture tonnage.

k. Dust Removed (accumulated to the nearest 0.1 ton (0.1 metric ton))

(2) Batch Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

e. RAS and FRAP weight to the nearest pound (kilogram).

f. Virgin asphalt binder weight to the nearest pound (kilogram).

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

1031.09 RAP in Aggregate Surface Course and Aggregate Wedge Shoulders, Type B. The use of RAP in aggregate surface course and aggregate shoulders shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except "Non-Quality" and "FRAP". The testing requirements of Article 1031.03 shall not apply. RAP used shall be according to the current Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

(b) Gradation. The RAP material shall meet the gradation requirements for CA 6 according to Article 1004.01(c), except the requirements for the minus No. 200 (75 µm) sieve shall not apply. The sample for the RAP material shall be air dried to constant weight prior to being tested for gradation."

STATUS OF UTILITIES (D-1)

Effective: June 1, 2016
Revised: January 1, 2020

Utility companies and/or municipal owners located within the construction limits of this project have provided the following information regarding their facilities and the proposed improvements. The tables below contain a description of specific conflicts to be resolved and/or facilities which will require some action on the part of the Department's contractor to proceed with work. Each table entry includes an identification of the action necessary and, if applicable, the estimated duration required for the resolution.

UTILITIES TO BE ADJUSTED

Conflicts noted below have been identified by following the suggested staging plan included in the contract. The company has been notified of all conflicts and will be required to obtain the necessary permits to complete their work; in some instances, resolution will be a function of the construction staging. The responsible agency must relocate, or complete new installations as noted below; this work has been deemed necessary to be complete for the Department's contractor to then work in the stage under which the item has been listed.

Pre-Stage

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
NA				

Stage 1

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
Prospect and Burlington	Electric Pole	Power pole east side of Prospect south of Burlington	**ComEd**	5 days

Stage 2

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
NA				

Pre-Stage: _____ Days Total Installation
Stage 1: __5_____ Days Total Installation
Stage 2: _____ Days Total Installation

UTILITIES TO BE WATCHED AND PROTECTED

The areas of concern noted below have been identified by following the suggested staging plan included for the contract. The information provided is not a comprehensive list of all remaining utilities, but those which during coordination were identified as ones which might require the Department's contractor to take into consideration when making the determination of the means and methods that would be required to construct the proposed improvement. In some instances, the contractor will be responsible to notify the owner in advance of the work to take place so necessary staffing on the owner's part can be secured.

Pre-Stage

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER
NA			

Stage 1

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER
East side of Prospect	Buried Cable	Buried Cable	ATT
North side of north train platform	Fiber Cable	Fiber Cable	Level 3

Stage 2

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER
NA			

The following contact information is what was used during the preparation of the plans as provided by the Agency/Company responsible for resolution of the conflict.

Agency/Company Responsible to Resolve Conflict	Name of contact	Phone	E-mail address
Centurylink	Ryan Burgeson	847-954-8213	ryan.burgeson@centurylink.com
Nicor	Bruce Koppang	630-388-3046	bkoppan@southernco.com
Comcast	Martha Gieras	224-229-5864	martha_gieras@comcast.com
AT&T	Janet Ahern	630-573-6414	ja1763@att.com
Flagg Creek Water	Jim Liubicich	630-323-3299 x6130	JLiubicich@fcwrd.org
ComEd	Likowa Ndobedi	630-890-0883	Likowo.ndobedi@comed.com
Level 3	Ryan Burgeson	847-954-8213	Ryan.burgeson@centurylink.com

AVAILABLE REPORTS

- ☐ No project specific reports were prepared.

When applicable, the following checked reports and record information is available for Bidders' reference upon request:

- ☐ Record Structural plans
- ■ Preliminary Site Investigation (PSI)
- ■ Preliminary Environmental Site Assessment (PESA)
- ■ Soils/Geotechnical Report
- ■ Boring Logs
- ☐ Pavement Cores
- ☐ Location Drainage Study (LDS)
- ☐ Hydraulic Report
- ☐ Noise Analysis
- ■ Other: Uncontaminated Soil Certification

Those seeking these reports should request access from:

David Landeweer (Project Manager)
TERRA Engineering
225 West Ohio Street, 4th Floor
Chicago, IL 60654
312-467-0123
8:00 AM to 4:30 PM

State of Illinois
Department of Transportation
Bureau of Local Roads and Streets

SPECIAL PROVISION FOR INSURANCE

Effective: February 1, 2007
Revised: August 1, 2007

All references to Sections or Articles in this specification shall be construed to mean specific Section or Article of the Standard Specifications for Road and Bridge Construction, adopted by the Department of Transportation.

The Contractor shall name the following entities as additional insured under the Contractor's general liability insurance policy in accordance with Article 107.27:

_____

_____

_____

_____

_____

_____

_____

The entities listed above and their officers, employees, and agents shall be indemnified and held harmless in accordance with Article 107.26.

DUPAGE COUNTY STORMWATER MANAGEMENT CERTIFICATE

PERMIT NO: 19110004

PROJECT: DOWNTOWN REVITALIZATION PROJECT

PROPERTY ADDRESS: 1 N PROSPECT AVE

PROPERTY OWNER: VILLAGE OF CLARENDON HILLS

CONTRACTOR: TERRA ENGINEER

DAN UNGERLEIDER, AICP
COMMUNITY DEVELOPMENT DIRECTOR
VILLAGE OF CLARENDON HILLS, ILLINOIS

DUPAGE COUNTY STORMWATER MANAGEMENT CERTIFICATION APPLICATION (1/2)

1. Community and Status	2. Date of Application	3. Stormwater Application No. (to be assigned by community)	4. DuPage County Tracking No.
Clarendon Hills ☐ Non ☑ Partial ☐ Complete	4/4/2019	1 9 1 1 0 0 0 4	

5. Applicant:

Name: Alex Heidtke
Company Name: TERRA Engineering, Ltd.
Address: 225 W Ohio Street, 4th Floor
City, ST, Zip: Chicago, IL 60657
Phone: 312-467-0123
Email: aheidtke@terraengineering.com

6. Owner:

Name: Dan Ungerleider
Company Name: Village of Clarendon Hills
Address: 1 N Prospect Avenue
City, ST, Zip: Clarendon Hills, IL 60514
Phone: 630-286-5400
Email: dungerleider@clarendonhills.us

7. Description of Proposed Development: Streetscape and train station improvements on Prospect, Ann, Golf, and Burlington Avenues including train station, shelter and canopy construction, road resurfacing, parking lot resurfacing, sidewalks, and associated utilities and stormwater management facilities

8. Location of Development:

Address: 1 S Prospect Avenue
Municipality: Clarendon Hills
Watershed Planning Area & Trib: Flagg Creek

9. Legal Description

¼ Section	Township	Range
11	38N	11E

PIN 09 - 11 - 502 - 006
PIN ____ - ____ - ____ - ____

10. Check all of the conditions which apply:

☐ Flood Plain ☐ Stormwater Detention ☑ Best Management Practices ☑ Soil Erosion & Sediment Control
☐ Wetland ☐ Wetland Buffer ☐ Riparian Buffer

11. Acknowledgement of On-Site Infiltration PCBMPs

I acknowledge that I have used my best effort to identify zones for which on-site infiltration are prohibited for Post Construction Best Management Practices (PCBMPs) in accordance with the Ordinance (15-63.B)

Signature of Applicant — Alex Heidtke (Print Name) — 4/4/19 (Date)

12. Freedom of Information Act (FOIA)

I acknowledge that all architects' drawings, engineers' technical submissions and other construction-related technical documents containing stormwater management information submitted with this application may be made available for inspection or copying by the County, notwithstanding 5 ILCS 140/7(1)(k), upon the written request for such materials. Such productions will be restricted to the following parties: i) the Applicant ii) any subsequent owner of the subject property; or iii) any governmental unit having planning or drainage jurisdiction within 1 and ½ mile of the subject property.

Signature of Applicant — Alex Heidtke (Print Name) — 4/4/19 (Date)
Signature of Owner — Dan Ungerleider (Print Name) — 4-4-2019 (Date)

13. Statement of Opinion for Minimum Criteria for Stormwater Management

I am a Professional Engineer under the employment of the Applicant. It is my professional opinion that the development meets the minimum criteria for stormwater management in accordance with the Ordinance (15-36)

Signature of Professional Engineer — Alex Heidtke (Print Name) — 4/4/19 (Date)

____ Community Copy ____ DuPage County SM Copy ____ Applicant Copy

DUPAGE COUNTY STORMWATER MANAGEMENT CERTIFICATION APPLICATION (2/2)

Community Tracking No: 191100054	DuPage County Tracking No:

14. Statement of Opinion for Presence of Flood Plain, Wetlands, and Buffers (15-47-A.5)

☐ I acknowledge the presence of flood plain.	☐ I acknowledge the presence of wetlands.	☐ I acknowledge the presence of buffers.
☑ I deny the presence of flood plain.	☑ I deny the presence of wetlands.	☑ I deny the presence of buffers.
Alex Heidtke — Signature of Qualified Professional — 4/4/19 Date	Alex Heidtke — Signature of Qualified Professional — 4/4/19 Date	Alex Heidtke — Signature of Qualified Professional — 4/4/19 Date
Alex Heidtke — Printed Name	Alex Heidtke — Printed Name	Alex Heidtke — Printed Name

15. Soil Erosion & Sediment Control Submittal Requirements (15-50.B)
(For developments with less than 1 acre of land disturbance that are not part of a larger common plan)

I certify that the development meets the soil erosion and sediment control design criteria found in Article VII have been met.

Signature of Qualified Designer | Print Name | Date

16. Soil Erosion & Sediment Control Requirements (15-59.W) (For developments with land disturbing activities greater than 1 acre)

I acknowledge that the site complies with the IEPA NPDES ILR10 Permit.

Alex Heidtke — Signature of Applicant | Alex Heidtke — Print Name | 4/4/19 — Date

17. Acknowledgement of Required As-Built Plans (15-47.B)

I acknowledge that a record drawing signed by either a Professional Engineer or a Professional Land Surveyor depicting the as-constructed size, rim, and invert elevations of pipes, stormwater structures and culverts, and contours and flood storage volumes of all required basins of the major stormwater systems and minor stormwater systems shall be submitted for review and approval upon completion of the stormwater facilities.

Alex Heidtke — Signature of Owner | Alex Heidtke — Print Name | 4/4/19 — Date

18. Intentional Misrepresentation Under Penalty of Perjury

I declare that I have examined and/or made this application and rider, and it is true and correct to the best of my knowledge and belief. I realize that the information that I have affirmed hereon forms a basis for the issuance of the stormwater management certification(s) herein applied for and approval of plans in connection therewith shall not be construed to permit any construction upon said premises or use thereof in violation of any provision of any applicable ordinance or to excuse the owner or his successors in title from complying therewith. The Owner and Applicant each understand and agree to construct said improvement in compliance with all provisions of the applicable ordinances.

Alex Heidtke — Signature of Applicant | Alex Heidtke — Print Name | 4/4/19 — Date

Dan Ungerleider — Signature of Owner | Dan Ungerleider — Print Name | 4-4-2019 — Date

DO NOTWRITE BELOW THIS LINE

19. Security (15-54)

Stormwater Facilities	$
Wetlands/Natural Area	$
SE/SC	$
Total	$

20. Stormwater Fees

Community Review	$
DCSM Review	$
Fee-in-Lieu	$ (Wetland) $ (BMP)

Seal/Stamp
Certifications expire December 31st of the third year of Certification or Authorization, whichever is earlier.

21. Final Approvals (See Certification letter for special conditions and general conditions.)

Community Certification 4/11/19 (Date) — Approved by/title

County Authorization — Date — Approved by/title

_____ Community Copy _____ DuPage County SM Copy ___358___ nt Copy

Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

Uncontaminated Soil Certification by Licensed Professional Engineer or Licensed Professional Geologist for Use of Uncontaminated Soil as Fill in a CCDD or Uncontaminated Soil Fill Operation LPC-663 Revised in accordance with 35 Ill. Adm. Code 1100, as amended by PCB R2012-009 (eff. Aug. 27, 2012)

This certification form is to be used by professional engineers and professional geologists to certify, pursuant to 35 Ill. Adm. Code 1100.205(a)(1)(B), that soil (i) is uncontaminated soil and (ii) is within a pH range of 6.26 to 9.0. If you have questions about this form, please telephone the Bureau of Land Permit Section at 217/524-3300.

This form may be completed online, saved locally, printed and signed, and submitted to prospective clean construction or demolition debris (CCDD) fill operations or uncontaminated soil fill operations.

I. Source Location Information

(Describe the location of the source of the uncontaminated soil)

Project Name: Proposed Prospect Ave. and Metra Improvements Office Phone Number, if available: _____

Physical Site Location (address, incldluding number and street):
Northeast Corner of Prospect Avenue and Ann Street

City: Clarendon Hills State: IL Zip Code: 60514

County: DuPage Township: _____

Lat/Long of approximate center of site in decimal degrees (DD.ddddd) to five decimal places (e.g., 40.67890, -90.12345):

Latitude: 41.797102 (Decimal Degrees) Longitude: -87.953943 (-Decimal Degrees)

Identify how the lat/long data were determined:

☐ GPS ☒ Map Interpolation ☐ Photo Interpolation ☐ Survey ☐ Other

IEPA Site Number(s), if assigned: BOL: _____ BOW: _____ BOA: _____

II. Owner/Operator Information for Source Site

Site Owner		Site Operator	
Name:	Village of Clarendon Hills	Name:	
Street Address:	1 North Prospect Avenue	Street Address:	
PO Box:		PO Box:	
City:	Clarendon Hills State: IL	City:	State:
Zip Code:	60514 Phone:	Zip Code:	Phone:
Contact:	Dan Ungerlaider	Contact:	
Email, if available:	dungerleider@clarendonhills.us	Email, if available:	

Project Name: Proposed Prospect Ave. and Metra Improvements

Latitude: 41.797102 Longitude: -87.953943

Uncontaminated Site Certification

III. Basis for Certification and Attachments

For each item listed below, reference the attachments to this form that provide the required information.

a. A Description of the soil sample points and how they were determined to be sufficient in number and appropriately located 35 Ill. Adm. Code 1100.610(a)]:

This form pertains to samples S-1 and S-2, which were collected at the location corresponding to the Latitude and Longitude above.

b. Analytical soil testing results to show that soil chemical constituents comply with the maximum allowable concentrations established pursuant to 35 Ill. Adm. Code Part 1100, Subpart F and that the soil pH is within the range of 6.25 to 9.0, including the documentation of chain of custody control, a copy of the lab analysis; the accreditation status of the laboratory performing the analysis; and certification by an authorized agent of the laboratory that the analysis has been performed in accordance with the Agency's rules for the accreditation of environmental and the scope of the accreditation [35 Ill. Adm. Code 1100.201(g), 1100.205(a), 1100.610]:

The representative samples were analyzed for polynuclear aromatic hydrocarbons (PNAs), All Metals, Volatile Organic Compounds (VOCs), and pH. The laboratory report and chain of custody documentation are available (see Available Reports special provision).

IV. Certification Statement, Signature and Seal of Licensed Professional Engineer or Licensed Professional Geologist

I, Adam M. Moghamis (name of licensed professional engineer or geologist) certify under penalty of law that the information submitted, including but not limited to, all attachments and other information, is to the best of my knowledge and belief, true, accurate and complete. In accordance with the Environmental Protection Act [415 ILCS 5/22.51 or 22.51a] and 35 Ill. Adm. Code 1100.205(a), I certify that the soil from this site is uncontaminated soil. I also certify that the soil pH is within the range of 6.25 to 9.0. In addition, I certify that the soil has not been removed from the site as part of a cleanup or removal of contaminants. All necessary documentation is attached.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Company Name: Applied GeoScience, Inc.

Street Address: 2385 Hammond Drive, Suite 6

City: Schaumburg State: IL Zip Code: 60173

Phone: 847-303-0300

Adam M. Moghamis
Printed Name:

Adam M Moghamis
Licensed Professional Engineer or
Licensed Professional Geologist Signature:

11-19-18
Date:

ADAM MOGHAMIS 062-049630 LICENSED PROFESSIONAL ENGINEER STATE OF ILLINOIS

P.E. or L.P.G. Seal:

101400
METRA SIGNAGE

Metra
Station Sign Program
Specification

March 1st 2017

TABLE OF CONTENTS

The sign system is designed to do three things:

1. Provide a uniform set of identification and directional signs at commuter stations.

2. Provide a cost effective system, both in the initial fabrication costs and in long term maintenance and replacement costs.

3. Provide durable signs that will withstand weathering and vandalism.

There are 10 sign types within the system. The system is a post and panel system with panels that slide and lock into posts. Panels must be able to be removed and replaced on site.

Materials for the signs must meet all ADA requirements for color and finish. Materials may vary depending on the types of signs and their uses. All materials, including paints, inks and overcoats should be exterior grade, compatible with each other and vandal resistant. The intent is to provide a cost effective system with a long life.

All hardware other than aluminum posts must be made of steel (rustproof) and tamper proof.

The drawings included in this manual are working drawings only, showing design intent for each sign. Minimal detail is shown in order that construction methods best suited to the individual vendor can be used while still meeting the aesthetic intent of each sign. Detailed engineering drawings for each existing sign type, based on the specifications in this manual, are the property of Metra. Any signs included in the specification manual not in existence and/or not presently in the sign maintenance program, must be designed/engineered by the vendor. The vendor is also responsible for detailed engineering drawings for these signs. All drawings must be approved by Metra prior to fabrication.

Additionally, before the sign fabrication process is started, the following must be submitted by the vendor:

1. Manufacturer's Technical Data Sheet for all paint materials used.

2. Manufacturer's Safety Data Sheet (MSDS) for all paint material used.

3. Sign prototype: typical sign panel and post section.

Lastly, the vendor must provide a Quality Assurance Program including inspection of work, preparation work control and spot check control.

All artwork, shop drawings, silkscreens and dies for signs shall be produced by the vendor and become the property of Metra.

PLEASE NOTE: Any new signs developed must be able to fit into existing posts.


Metra

Corporate Colors:

Pantone 301C

White

Corporate Type Style:

Helvetica Bold Condensed

ABCDEFGHIJKLM NOPQRSTU VWXYZ

abcdefghijklmnopqrstuvwxyz

1234567890$(&.,:;!?'–)

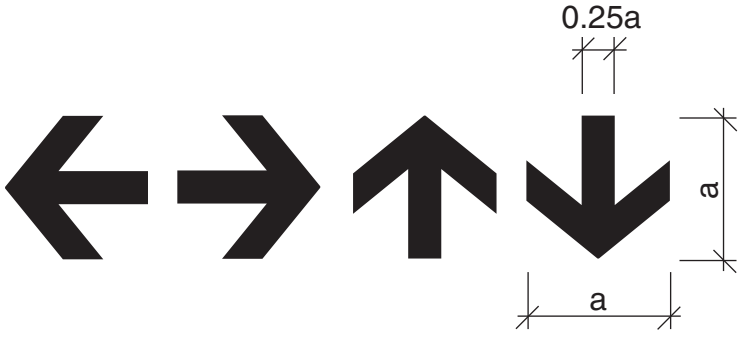
Helvetica Medium

ABCDEFGHIJKLMNOPQRSTU VWXYZ

abcdefghijklmnopqrstuvwxyz

1234567890$(&.,:;!?'–)

Arrow Style:

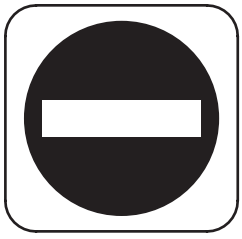


Parking

No Parking

Smoking

No Smoking



Do Not Enter

Notice

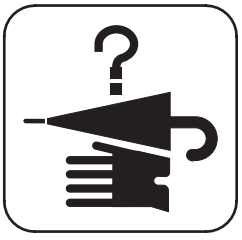
Metra Police

Train Station

Men

Women

Men and Women

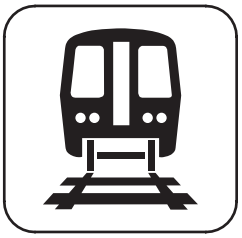


Lost and Found

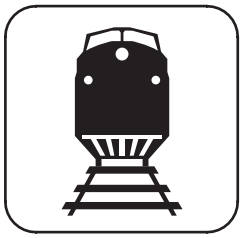
Kiss N Ride

Taxi

Bus

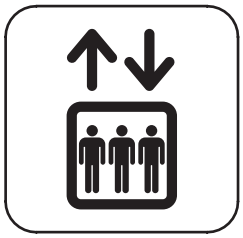


Rapid Transit



Commuter Rail

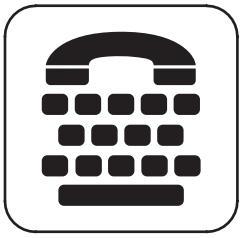
Tickets



Elevator

Disabled

Telephone



TDD

Volume Control

Vending

BNSF Line

Union Pacific North Line

Union Pacific Northwest Line

Union Pacific West Line

Electric District Line

Electric District Blue Island Branch Line

Electric District South Chicago Line

Heritage Corridor Line

Milwaukee District North Line

Milwaukee District West Line

SouthWest Service Line

North Central Service Line

Rock Island District Line

Rock Island District - Beverly Line

South Shore Line

BNSF Line:

Chicago Union Station (CUS)*
Halsted Street
Western Avenue
Cicero
La Vergne
Berwyn
Harlem Ave.
Riverside
Hollywood (Zoo Stop)
Brookfield
Congress Park
LaGrange Road *
Stone Avenue (LaGrange)
Western Springs
Highlands
Hinsdale
West Hinsdale
Clarendon Hills
Westmont
Fairview Avenue (Downers Grove)
Main Street (Downers Grove)
Belmont
Lisle
Naperville*
Route 59
Aurora

* *Station is also an Amtrak Station*

Union Pacific North Line:

Chicago Ogilvie Transportation Center (OTC)

Clybourn

Ravenswood

Peterson Ridge***

Rogers Park

Main Street (Evanston)

Davis Street (Evanston)

Central Street (Evanston)

Wilmette

Kenilworth

Indian Hill

Winnetka

Hubbard Woods

Glencoe

Braeside

Ravinia Park

Ravinia

Highland Park

Highwood

Fort Sheridan

Lake Forest

Lake Bluff

Great Lakes

North Chicago

Waukegan

Zion

Winthrop Harbor

Kenosha

*** Potential New Station

Union Pacific Northwest Line:	Chicago Ogilvie Transportation Center (OTC)
	Clybourn
	Irving Park
	Jefferson Park
	Gladstone Park
	Norwood Park
	Edison Park
	Park Ridge
	Dee Road
	Des Plaines
	Cumberland
	Mount Prospect
	Arlington Heights
	Arlington Park
	Palatine
	Barrington
	Fox River Grove
	Cary
	Pingree Road
	Crystal Lake
	McHenry
	Woodstock
	Harvard

Union Pacific West Line:	Chicago Ogilvie Transportation Center (OTC)
	Kedzie
	Oak Park
	River Forest
	Maywood
	Melrose Park
	Bellwood
	Berkeley
	Elmhurst
	Villa Park
	Lombard
	Glen Ellyn
	College Avenue
	Wheaton
	Winfield
	West Chicago
	Geneva
	La Fox
	Elburn

Electric District Line:

Millenium Station **
Van Buren Street **
Museum Campus/11th Street **
18th Street/Soldier Field
McCormick Place **
27th Street
47th Street/Kenwood
51st/53rd Street/Hyde Park
55th-56th-57th Street **
59th Street/University of Chicago
63rd Street **
75th Street/Grand Crossing
79th Street/Chatham
83rd Street/Avalon Park
87th Street/Woodruff
91st Street/Chesterfield
95th Street/Chicago State University
103rd Street/Rosemoor
107th Street
111th Street/Pullman
115th Street/Kensington **

Riverdale
Ivanhoe
147th Street/Sibley Boulevard
Harvey
Hazel Crest
Calumet
Homewood*
Flossmoor
Olympia Fields
211th Street/Lincoln Highway
Matteson
Richton Park
University Park

* *Station is also an Amtrak Station*
** *Station is also a NICTD Station*

Electric District	State Street
Blue Island Branch Line:	
	Stewart Ridge
	West Pullman
	Racine Avenue
	Ashland Avenue
	Burr Oak
	Blue Island

Electric District	Stony Island
South Chicago Line:	
	Bryn Mawr
	South Shore
	75th Street/Windsor Park
	79th Street/Cheltenham
	83rd Street
	87th Street
	93rd Street South Chicago
Heritage Corridor Line:	Chicago Union Station (CUS)*
	Summit*
	Willow Springs
	Lemont
	Romeoville***
	Lockport
	Joliet*

* *Station is also an Amtrak Station*

*** *Potential New Station*

Milwaukee District North Line:	Chicago Union Station (CUS)*
	Western Avenue
	Healy
	Grayland
	Mayfair
	Forest Glen
	Edgebrook
	Morton Grove
	Golf
	Glenview*
	The Glen/North Glenview
	Northbrook
	Lake Cook Road
	Deerfield
	Lake Forest
	Libertyville
	Prairie Crossing
	Grayslake
	Round Lake
	Long Lake
	Ingleside
	Fox Lake

* *Station is also an Amtrak Station*

Milwaukee District West Line:

Chicago Union Station (CUS)*

Western Avenue

Grand/Cicero

Hanson Park

Galewood

Mars

Mont Clare

Elmwood Park

River Grove

Franklin Park

Mannheim

Bensenville

Wood Dale

Itasca

Medinah

Roselle

Schaumburg

Hanover Park

Bartlett

National Street (Elgin)

Elgin

Big Timber Road (Elgin)

* *Station is also an Amtrak Station*

SouthWest Service Line:

Chicago Union Station (CUS)*

Wrightwood

Ashburn

Oak Lawn

Chicago Ridge

Worth

Palos Heights

Palos Park

143rd Street (Orland Park)

153rd Street (Orland Park)

179th Street (Orland Park)

Laraway Road (New Lenox)

Manhattan

* *Station is also an Amtrak Station*

North Central Service Line:

Chicago Union Station (CUS)*

Western Avenue

River Grove

Belmont Avenue (Franklin Park)

Schiller Park

Rosemont

O'Hare Transfer

Prospect Heights

Wheeling

Buffalo Grove

Prairie View

Vernon Hills

Mundelein

Prairie Crossing

Washington Street (Grayslake)

Round Lake Beach

Lake Villa

Antioch

* *Station is also an Amtrak Station*

Rock Island District Line:

LaSalle Street Station

35th Street / “Lou” Jones / Bronzeville

Gresham

95th Street/Longwood

103rd Street/Washington Heights

Blue Island/Vermont Street

Robbins

Midlothian

Oak Forest

Tinley Park

80th Avenue/Tinley Park

Hickory Creek/Mokena

Mokena

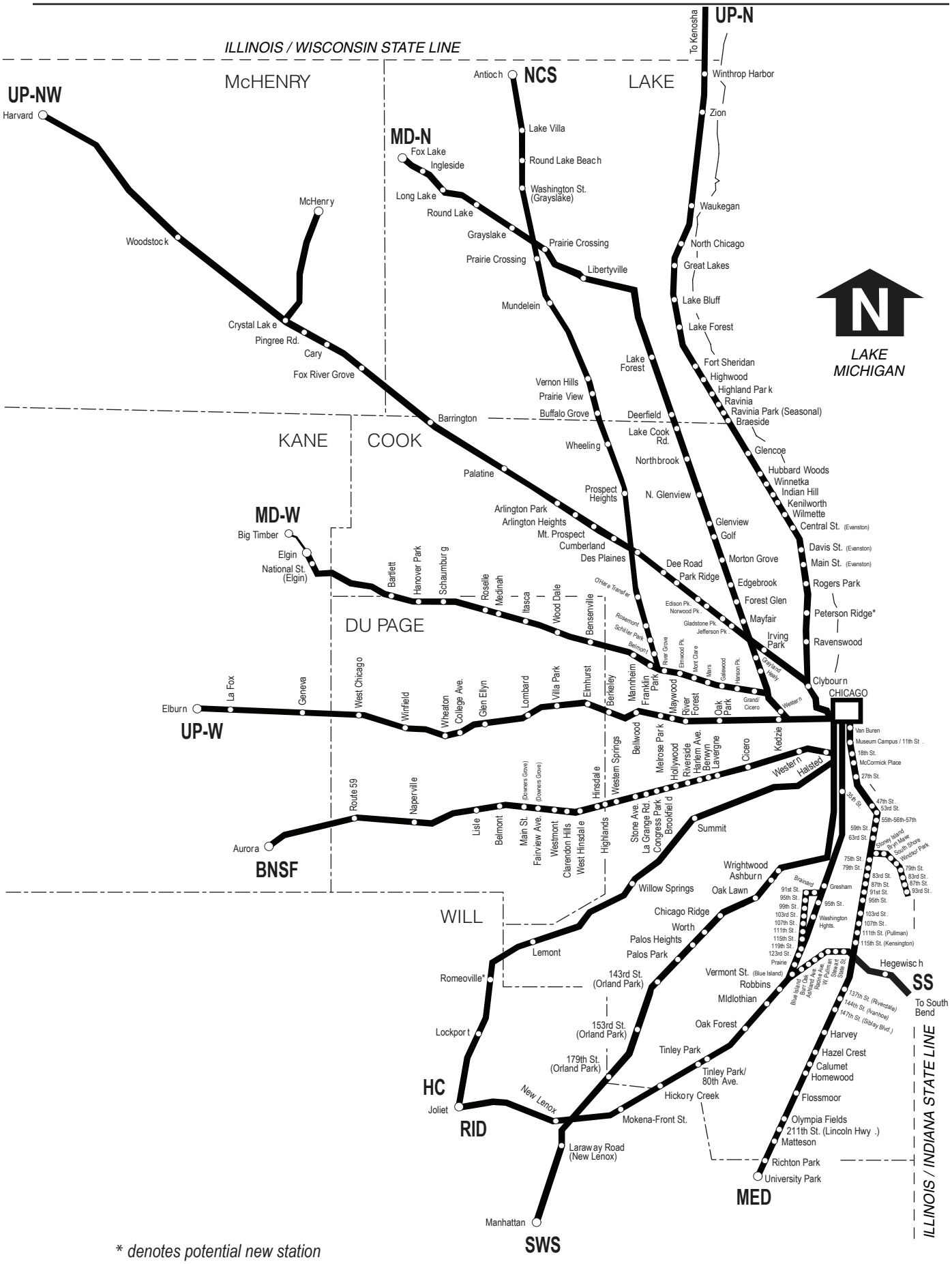
New Lenox

Joliet*

* *Station is also an Amtrak Station*

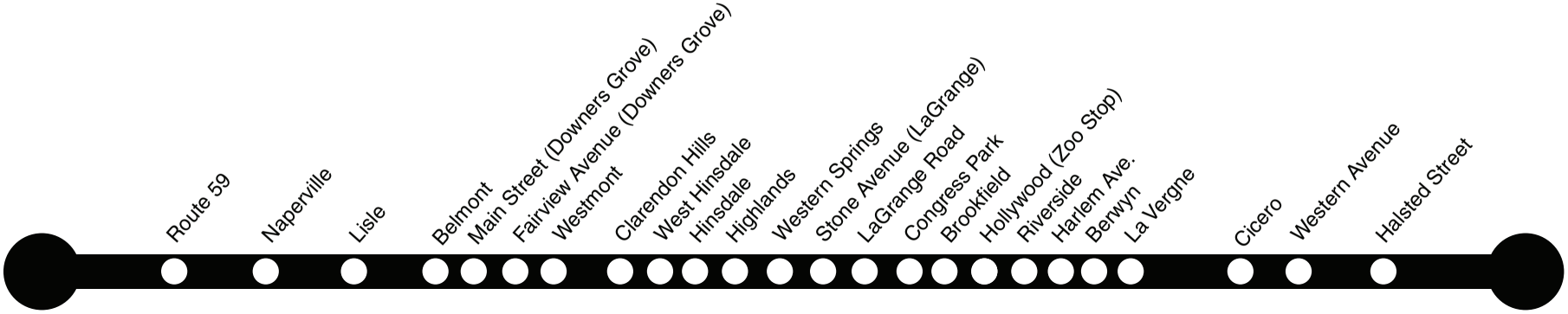
Rock Island District - Beverly Line:	Brainerd
	91st Street/Beverly Hills
	95th Street/Beverly Hills
	99th Street/Beverly Hills
	103rd Street/Beverly Hills
	107th Street/Beverly Hills
	111th Street/Morgan Park
	116th Street/Morgan Park
	119th Street
	123rd Street
	Prairie Street
	Blue Island/Vermont Street

South Shore Line: *(Stations that are in Illinois)*	Millennium Station at Randolph
	Van Buren St.
	Museum Campus / 11th St.
	McCormick Place
	55th - 56th - 57th St.
	63rd St.
	Kensington / 115th St.
	Hegewisch



** denotes potential new station*

BNSF



Aurora

Chicago
Union Station (CUS)

Union Pacific North Line

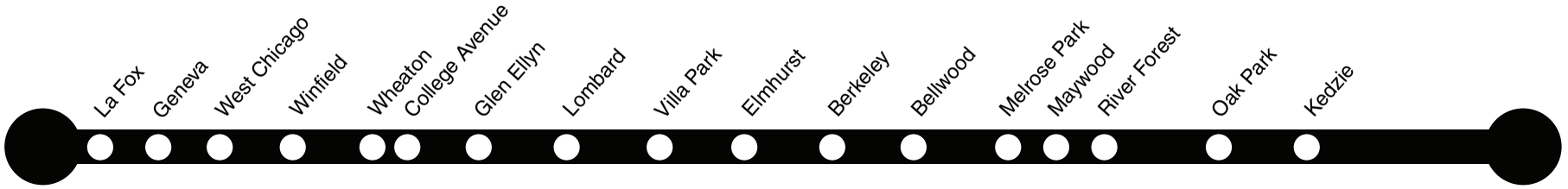
Kenosha

Chicago Ogilvie Transportation Center (OTC)

*potential new station

Union Pacific Northwest Line

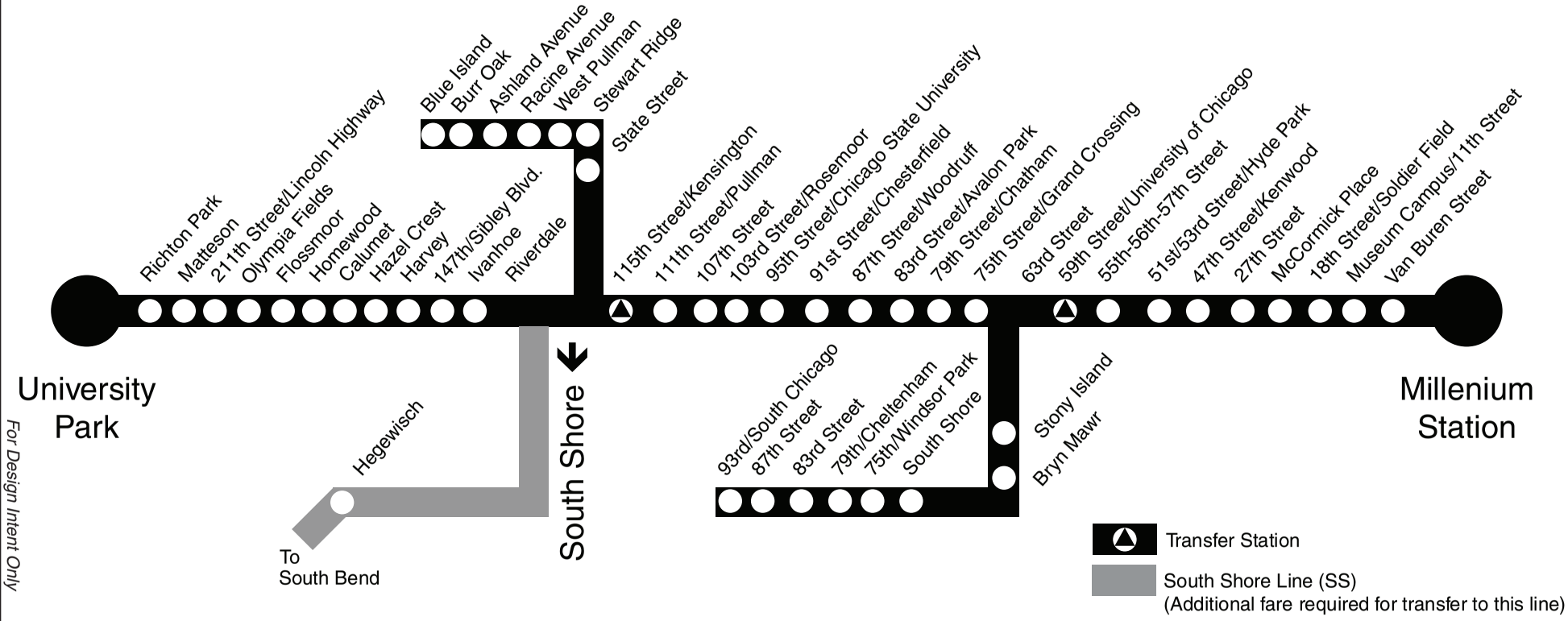
Union Pacific West Line



Elburn

Chicago Ogilvie Transportation Center (OTC)

Metra Electric District



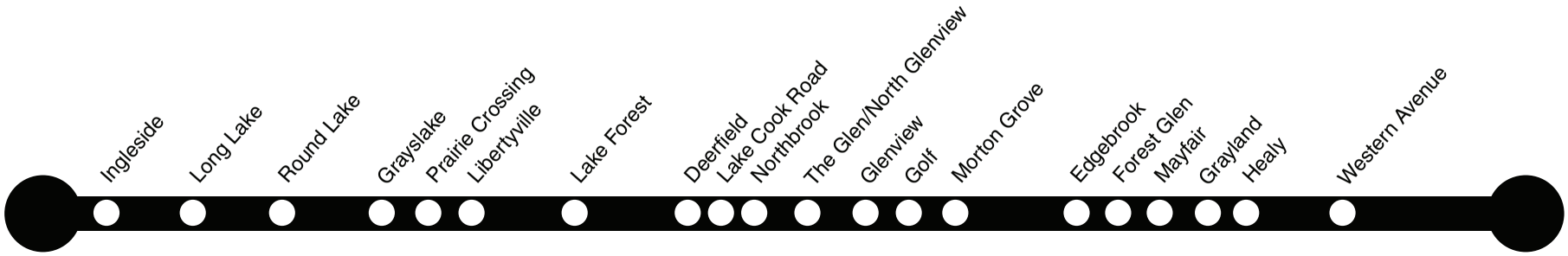
Heritage Corridor

Joliet

Chicago
Union Station (CUS)

*potential new station

Milwaukee District North Line



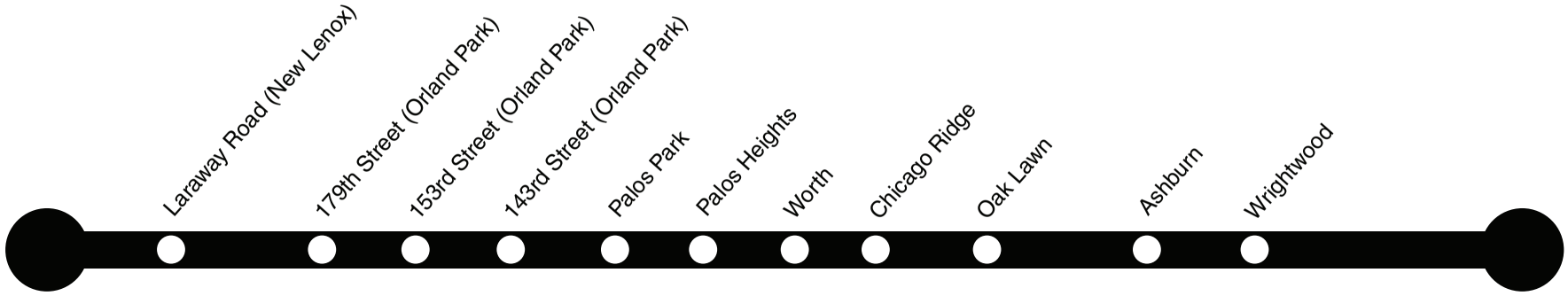
For Design Intent Only

Milwaukee District West Line

Big Timber Road
(Elgin)

Chicago
Union Station (CUS)

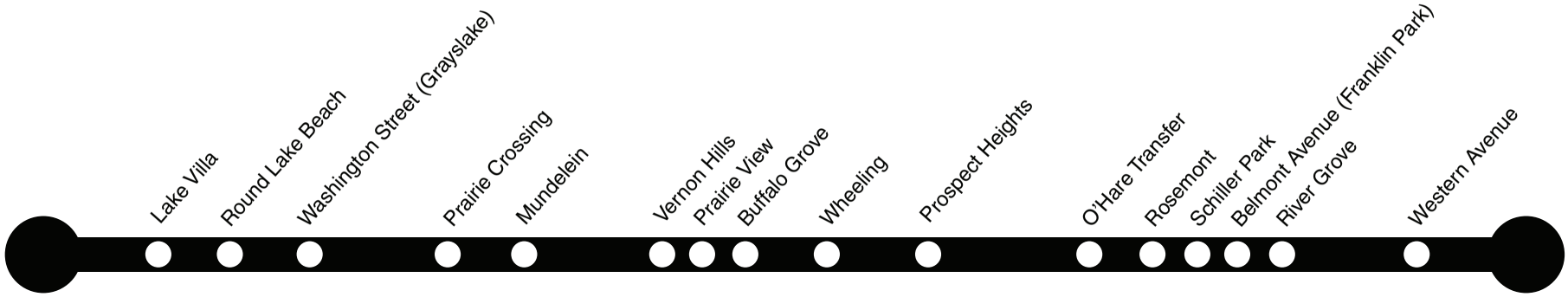
SouthWest Service



Manhattan

Chicago
Union Station (CUS)

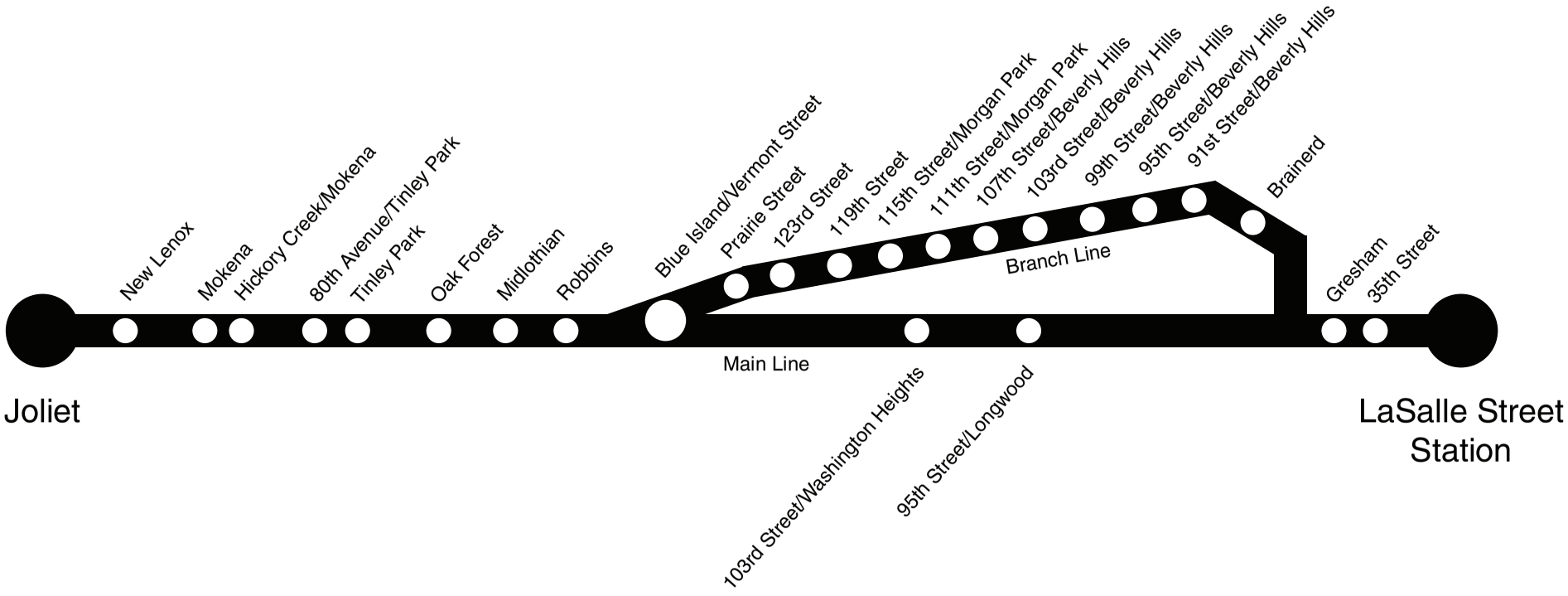
North Central Service



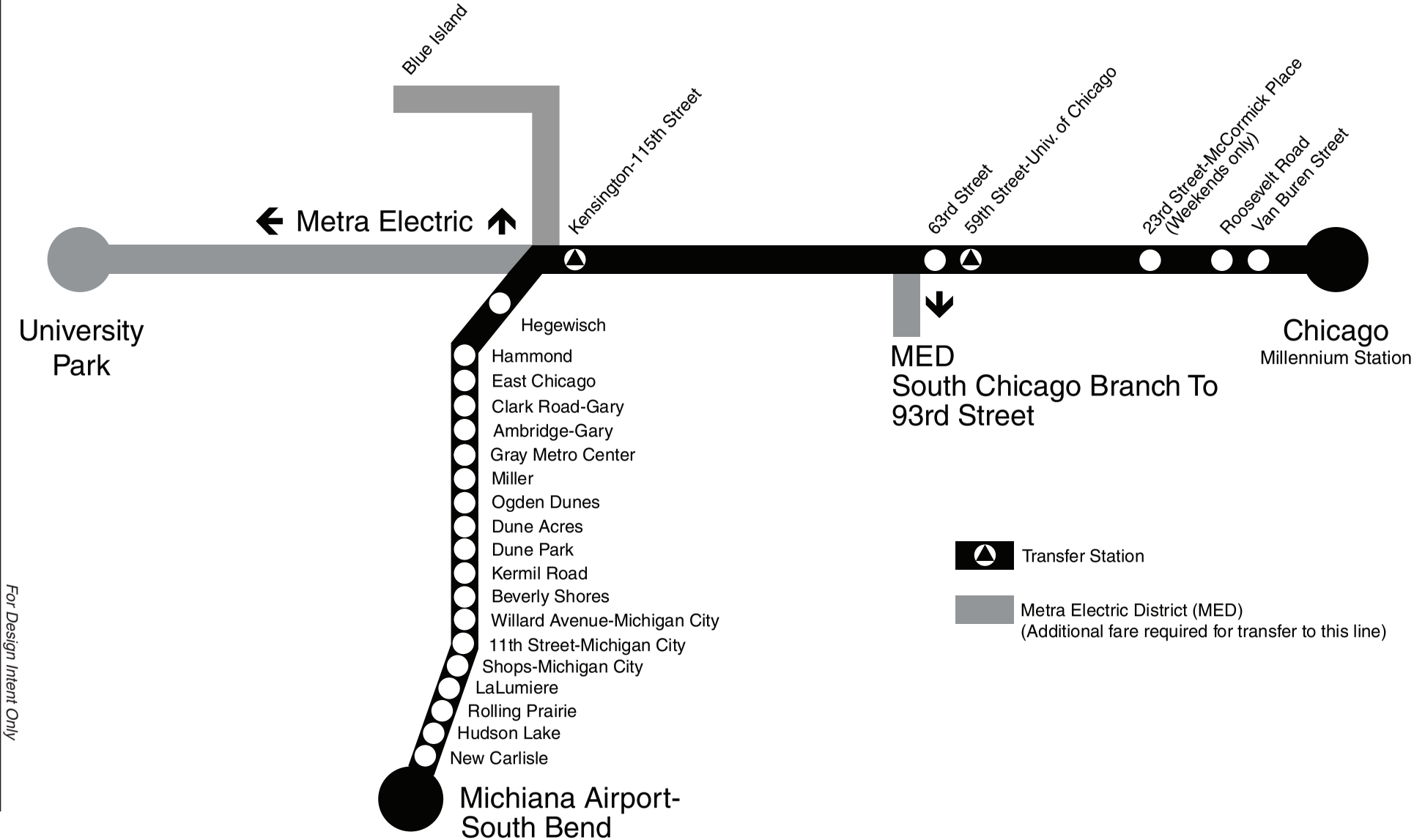
Antioch

Chicago
Union Station (CUS)

Rock Island District



South Shore Line



Sign type 1	Primary Station Identifier
Sign type 2	Parallel Platform Station Identifier
Sign type 3	Information Display Board
Sign type 4	Primary Identification / Directional
Sign type 5	Secondary Identification / Directional
Sign type 6	Door Identifier and Special Instruction Signs
Sign type 7	Tertiary Identification / Directional
Sign type 8	Vinyl Decal
Sign type 9	Trailblazer Sign
Sign type 10	Caution Sign

Description:

Major Station Identifiers
These signs are used to identify stations for passengers, operating personnel, pedestrians and motorists. The station name is used in conjunction with the Metra logo. Three sizes of these sign types are available, to be used in accordance with structure size. There is a one line and two line condition for the major station identifiers, since some stations have secondary names.

Minor Station Identifiers
The main purpose of the 1D sign is to identify the station for commuters, specifically the visually impaired. The station name appears in tactile letters and braille. It is to be placed at the station entrance on the platform side. Location shall be as uniform as possible within the system. A secondary sign panel may also be used to provide phone numbers and addresses for commuter information in tactile and braille form, or to display the Metra logo.

Mounting for Major Station Identifiers:

Signs shall be mounted to the roof, eaves or side of station structure, both parallel and perpendicular to the tracks, as appropriate. All signs must be capable of being surface, roof, or eave mounted. All surface mounted signs are to be supplied with one-way tamper proof screws and should be compatible with wood, metal or masonry surfaces. Mounting system for roof mounted signs must accommodate roofs of varying slopes (see page 247 - 249). All signs shall utilize vertical mountings.

Mounting for Minor Station Identifiers:

Surface mounted signs are to be supplied with one-way tamper proof screws compatible with wood, metal or masonry surfaces (see page 250).

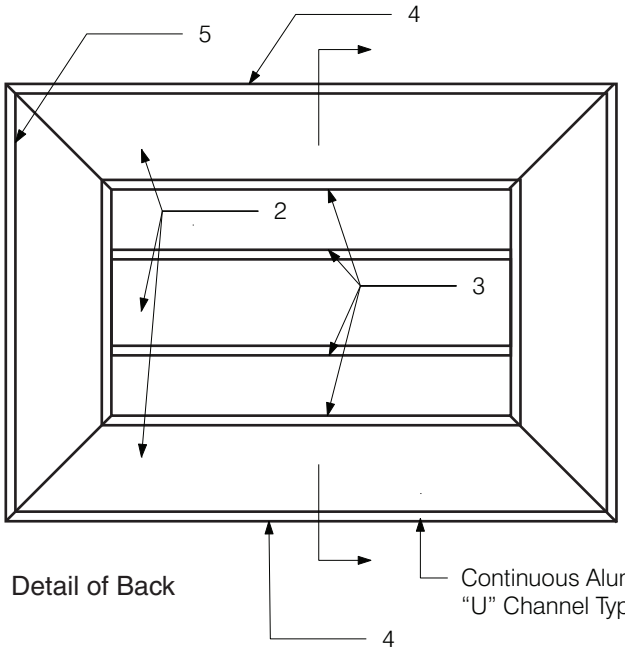
Mounting conditions for post mounted signs include concrete, asphalt, dirt, and wooden platforms. Signs must be capable of being mounted by concrete embedment or plate and anchor bolts (see page 244 - 246).

Concrete Embedment
Aluminum posts are typically embedded 3 ft. directly into concrete footings. Add the distance below grade to post length for direct burial mounting.

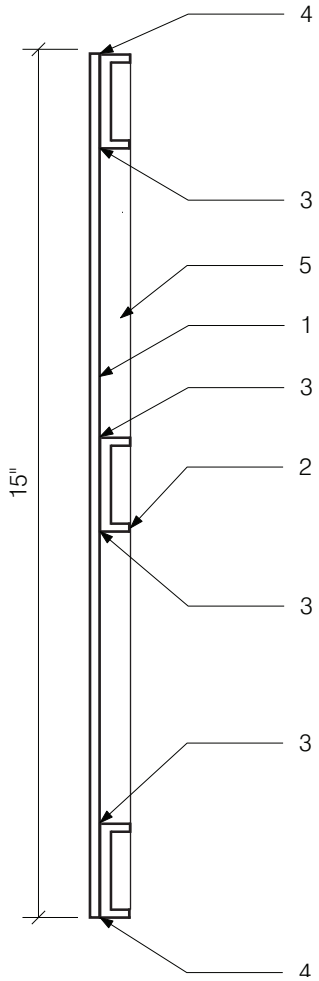
Plate and Bolt Mounted
Welded aluminum flange plates are mechanically fastened to J-bolts or anchor bolts embedded into concrete footings.

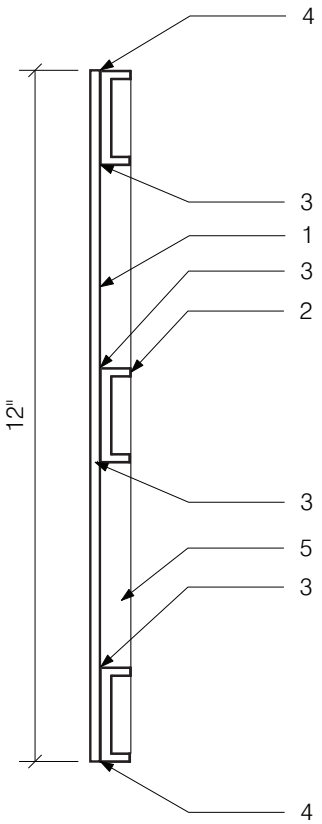
Following are specifications and schematics for Type 1 signs.

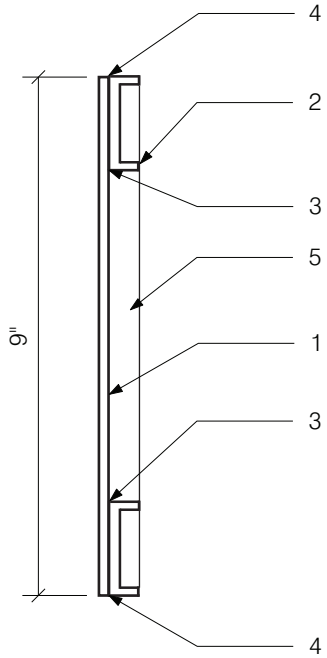
1. 0.125” Aluminum sign plate
2. 1 1/2” x 1/2” x 1/8” Continuous aluminum “U” channel supports full length of the sign face
3. Continuous weld bead Typ.
4. Continuous weld to be ground smooth on outer perimeter of sign plate
5. End closure channel



Detail of Back







Sign Type 1:

1B Major Station Identifier (15”H x 132”W)

1C Major Station Identifier (12”H x 98.5”W)

1D Minor Station Identifier with Braille (12”H x 26”W)

1Da Minor Station Identifier with Braille (4 1/2”H x 9”W)

1E Major Station Identifier with Amtrak Logo (15”H x 132”W)

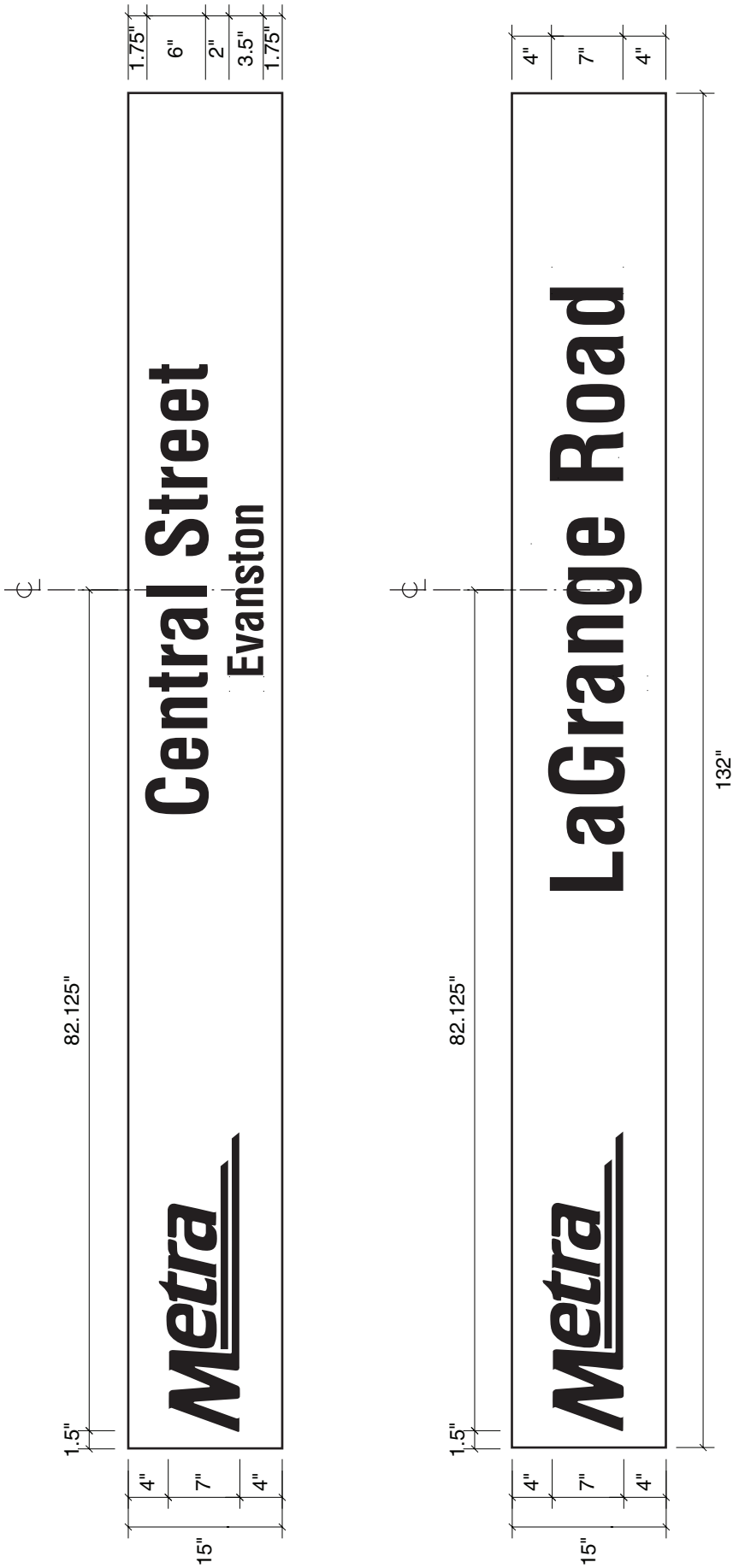
1F Major Station Identifier with Amtrak Logo (12”H x 98.5”W)

1G Major Station Identifier (9”H x 72”W)

1H Major Station Identifier with NICTD Logo (15”H x 132”W)

1J Major Station Identifier with NICTD Logo (12”H x 98.5”W)

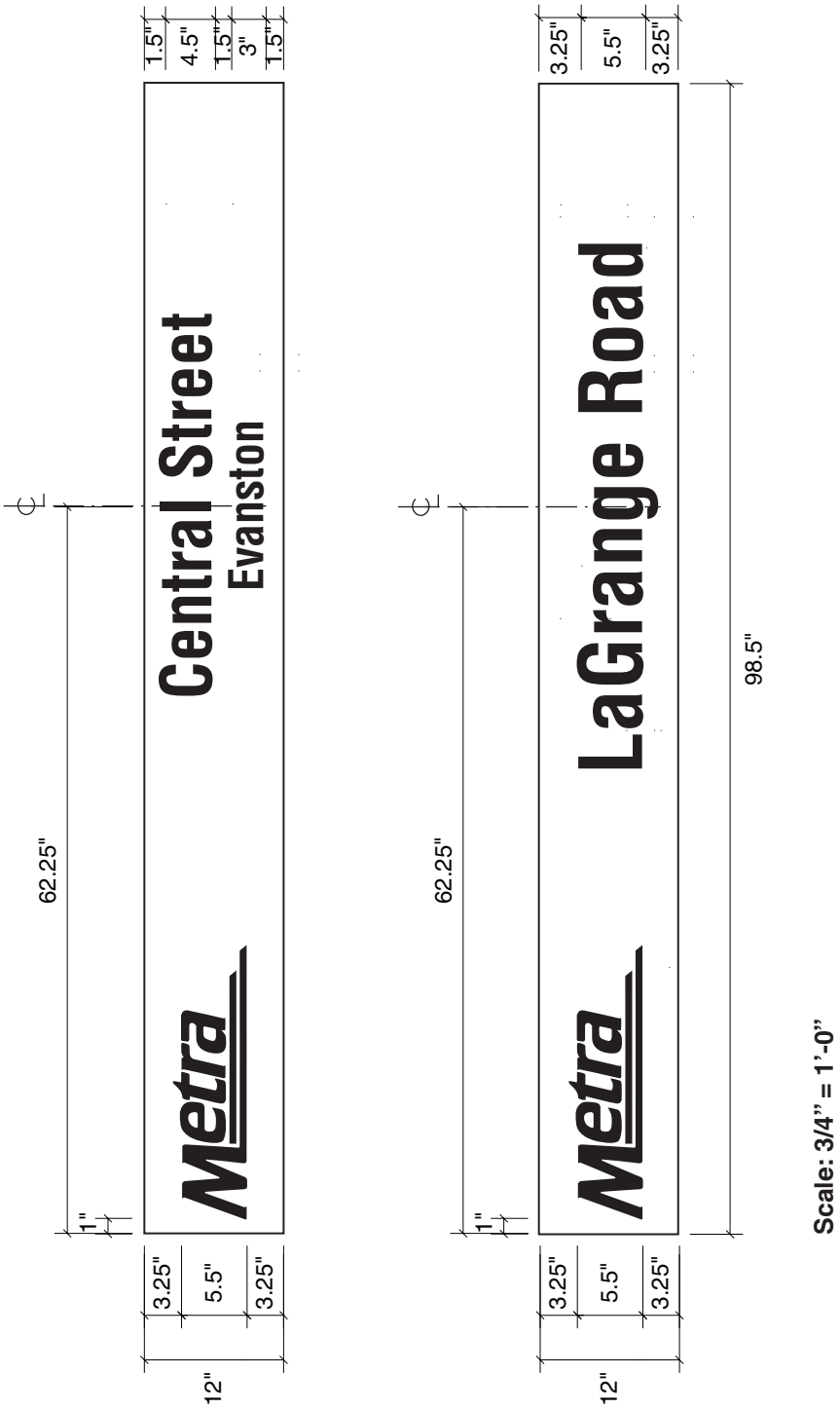
SIGN TYPE 1B	Major Station Identifier (15”H x 132”W) Specifications
Size:	15” H X 132” W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	One line condition - 7” Cap height Two line condition - 6” Cap height on station name 3 1/2” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White



Scale: 3/4” = 1’-0”

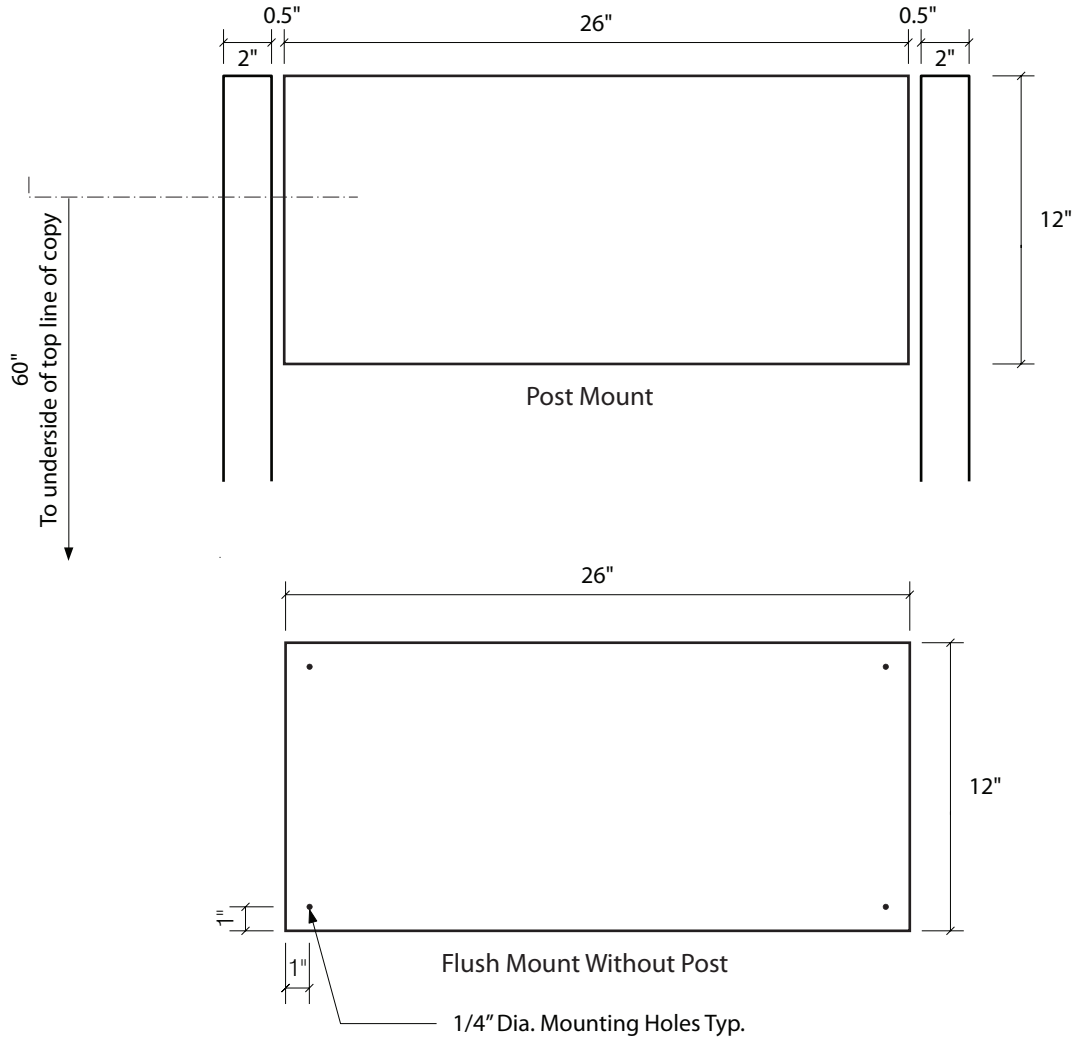
For Design Intent Only

SIGN TYPE 1C	Major Station Identifier (12”H x 98.5”W) Specifications
Size:	12” H X 98.5” W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37).
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	One line condition - 5 1/2” Cap height Two line condition - 4 1/2” Cap height on station name 3” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White

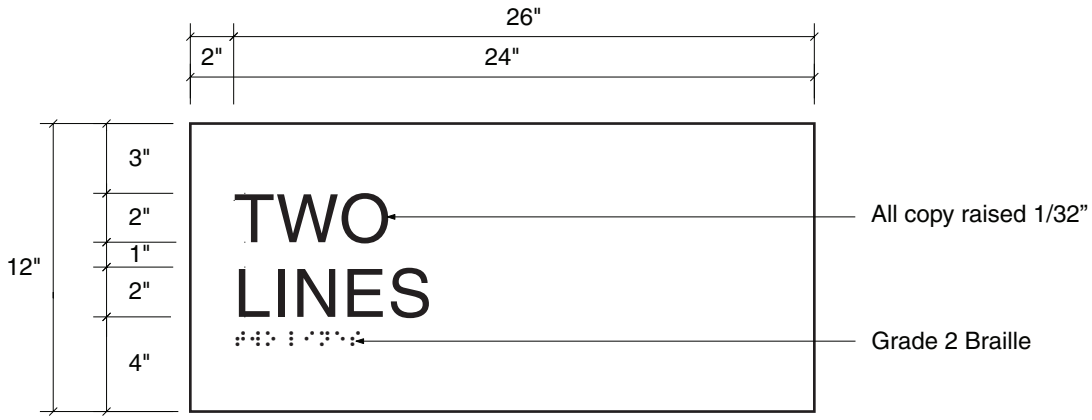

Central Street
Evanston
Metra
LaGrange Road
Metra
62.25"
1"
1.5"
4.5"
1.5"
3"
1.5"
3.25"
5.5"
3.25"
12"
98.5"

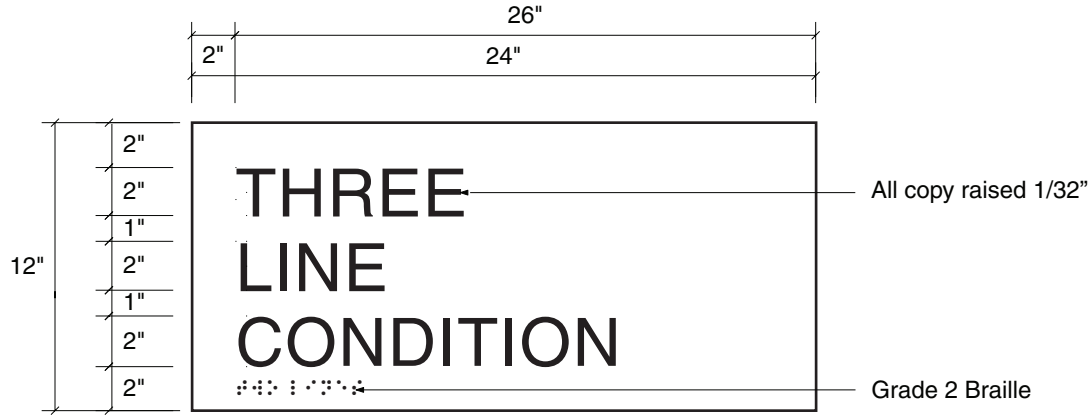
Scale: 3/4” = 1’-0”

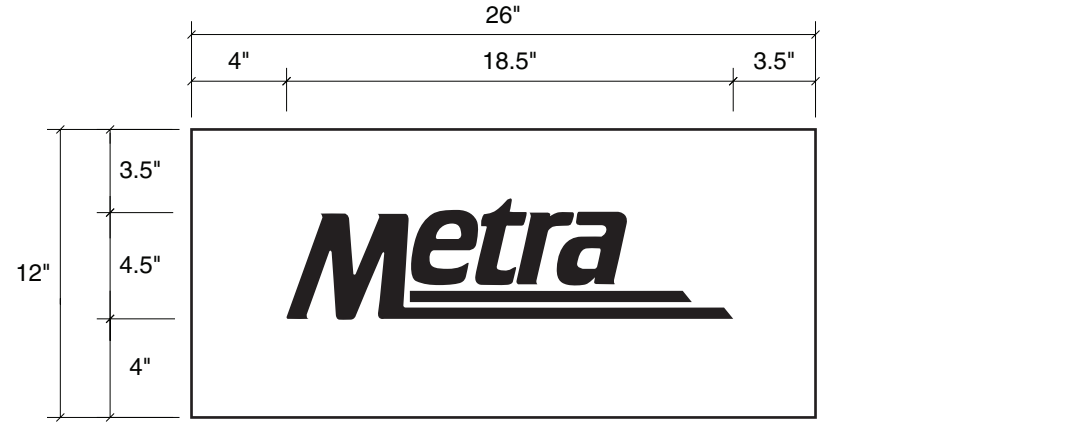
SIGN TYPE 1D	Minor Station Identifier with Braille (12”H x 26”W) Specifications
Post Height:	Varies
Mounting Height:	60” to underside of 1st line of copy
Post Material:	2” x 2” aluminum (Used for ground-mounted. Same post as sign type 2A and 4)
Post & Reveal Color:	Black anodized finish
Panel Size:	12” H x 26” W
Panel Material:	Etched zinc, constructed of materials that are vandal-resistant, and scratch, fade and weather resistant. (See details on pages 61).
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Tactile Copy:	Letters raised 1/32” by metal etched process.
Letterform:	Helvetica Medium upper case or Metra logo
Copy Size:	2” cap height 4 1/2 height of “M” in “METRA” when logo is used
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Braille:	Grade 2 Rastors by metal etched process.


0.5"
26"
0.5"
2"
2"
12"
60"
To underside of top line of copy
Post Mount
26"
12"
1"
1"
Flush Mount Without Post
1/4” Dia. Mounting Holes Typ.

Scale: 1 1/2” = 1’-0”

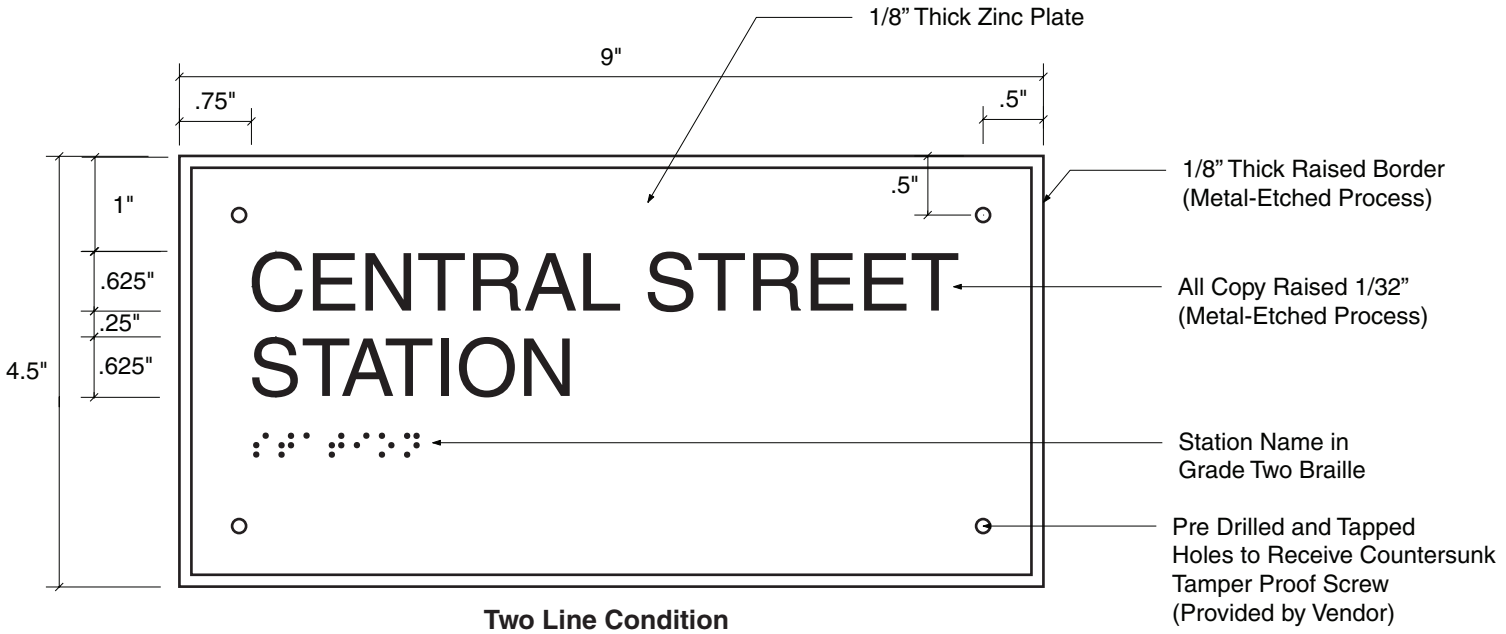

26"
2"
24"
12"
3"
2"
1"
2"
4"
TWO
LINES
All copy raised 1/32”
Grade 2 Braille


26"
2"
24"
12"
2"
2"
1"
2"
1"
2"
2"
THREE
LINE
CONDITION
All copy raised 1/32”
Grade 2 Braille

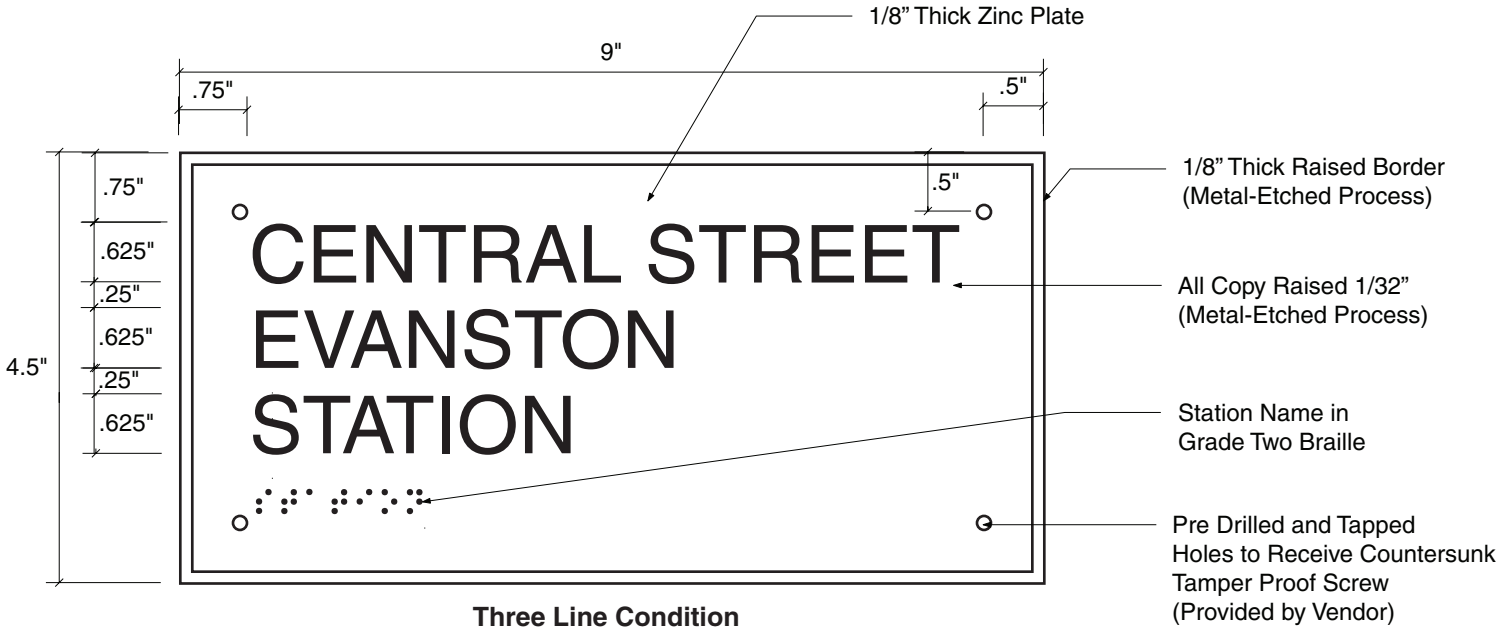

26"
4"
18.5"
3.5"
12"
3.5"
4.5"
4"
Metra

Scale: 1 1/2” = 1’-0”

SIGN TYPE 1Da	Minor Station Identifier with Braille (4 1/2"H x 9"W) Specifications
Post Height:	8'-5"
Mounting Height:	60" to underside of 1st line of copy
Post Material:	3" x 3" aluminum post welded to 4 1/2" x 9" x 1/4" aluminum plate with 4 holes to receive sign panel
Post & Plate Color	Black anodized finish
Panel Size:	4 1/2" H x 9" W
Material:	Sign panel to be 1/8" thick vandal-resistant zinc material. It shall be scratch, fade and weather resistant.
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Tactile Copy:	Letters raised 1/32" by metal etched process.
Letterform:	Helvetica Medium upper case
Copy Size:	5/8" cap height
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border Color:	White
Braille:	Grade 2 Rastors by metal etched process.



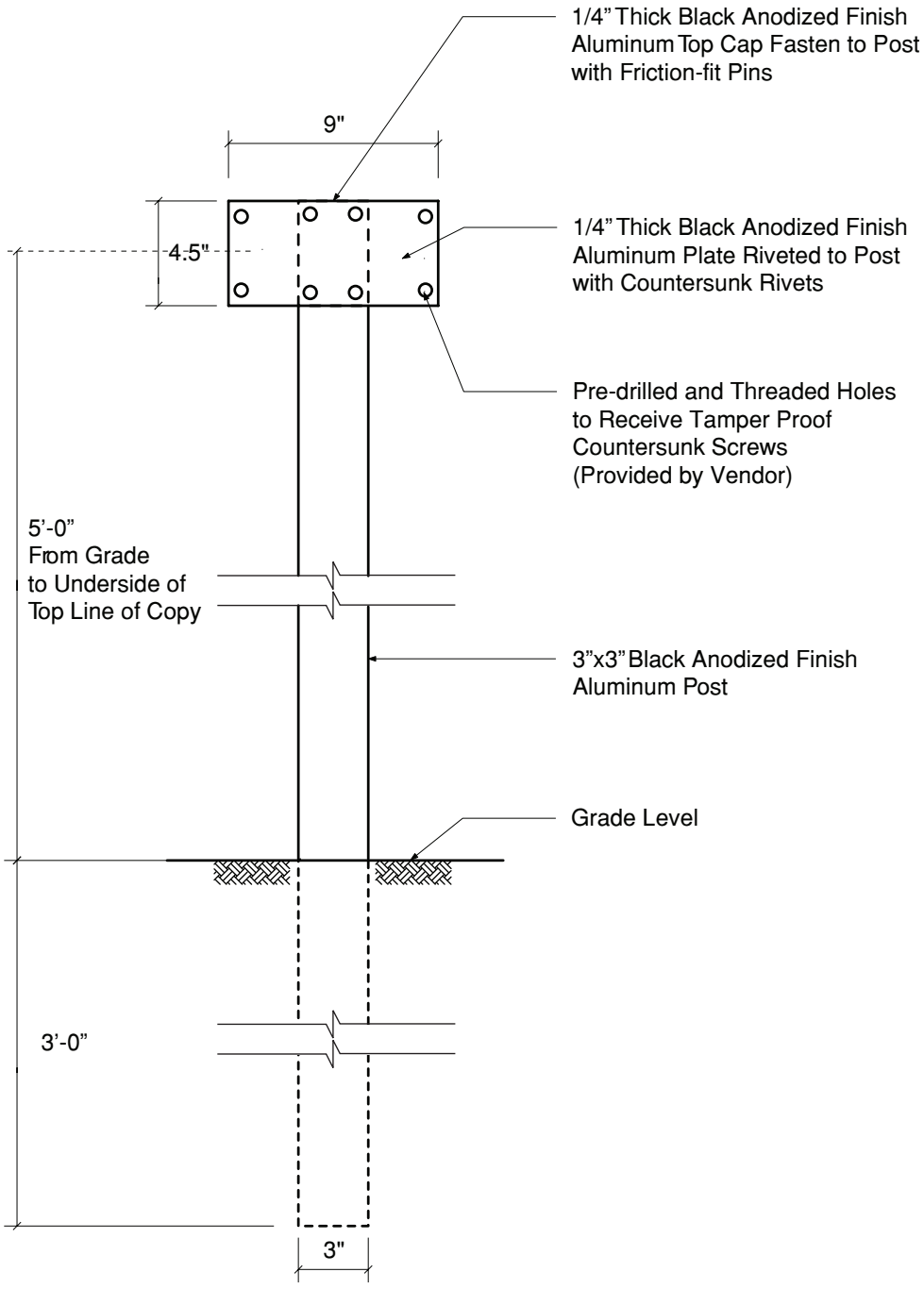
Two Line Condition



Three Line Condition

Note: Grade Two Braille drawn is merely representational.

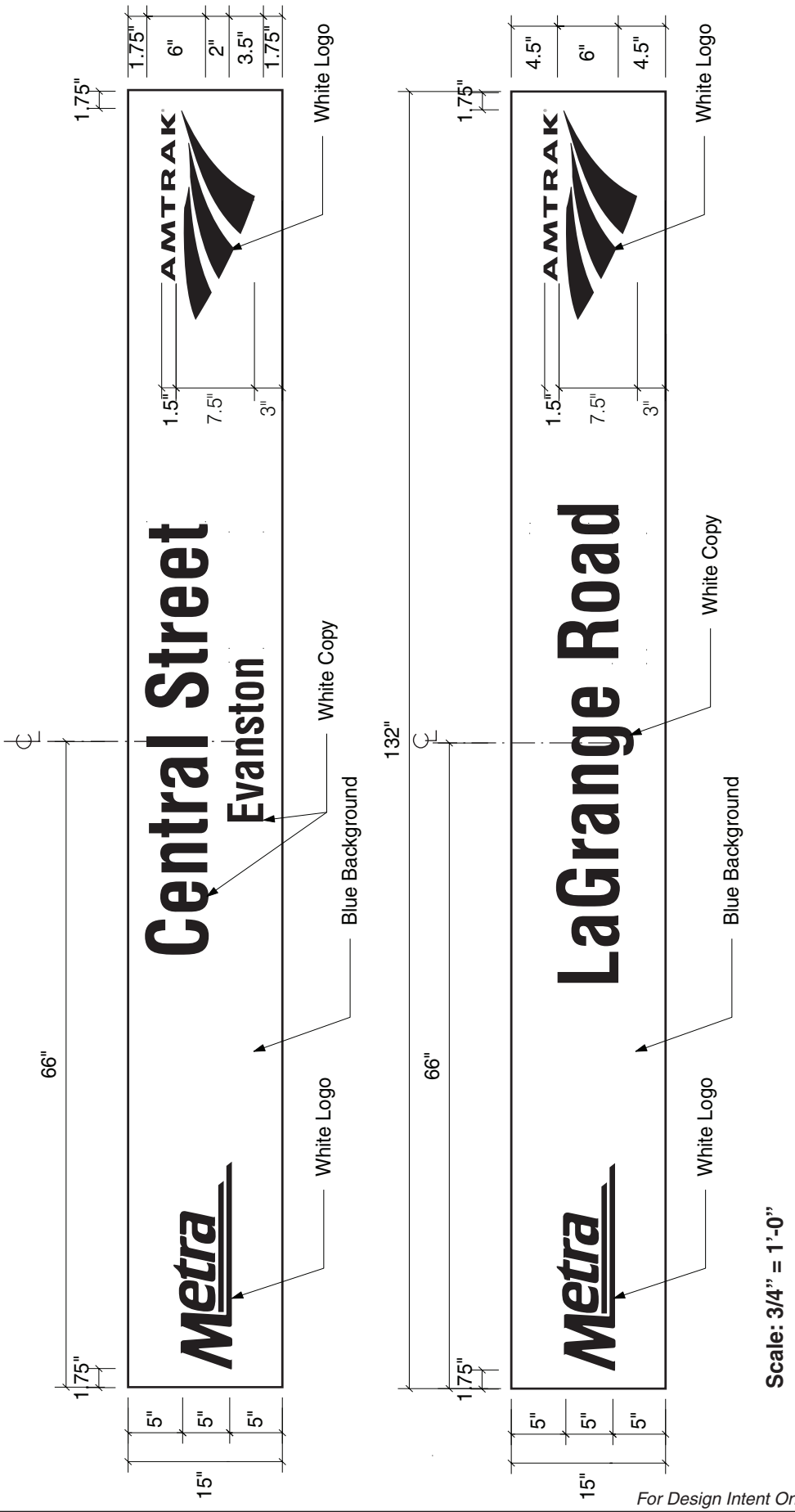
Scale: Half Size



Post Mount

Scale: 1 1/2" = 1'-0"

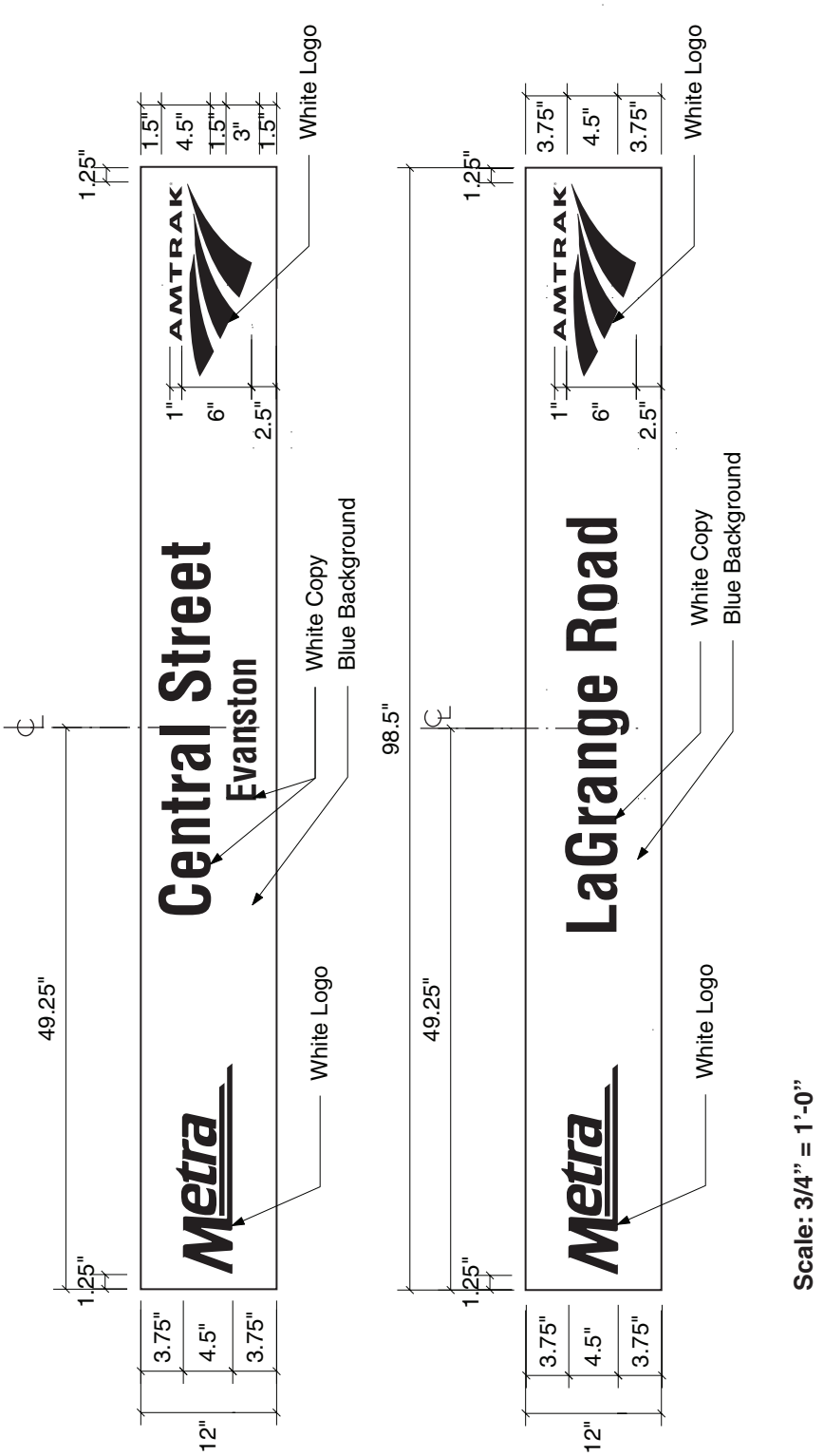
SIGN TYPE 1E	Major Station Identifier with Amtrak Logo (15”H x 132”W) Specifications
Size:	15” H X 132” W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case, Metra logo and Amtrak logo
Copy Size:	One line condition - 6” Cap height on station name Two line condition - 6” Cap height on station name 3 1/2” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White



Scale: 3/4” = 1’-0”

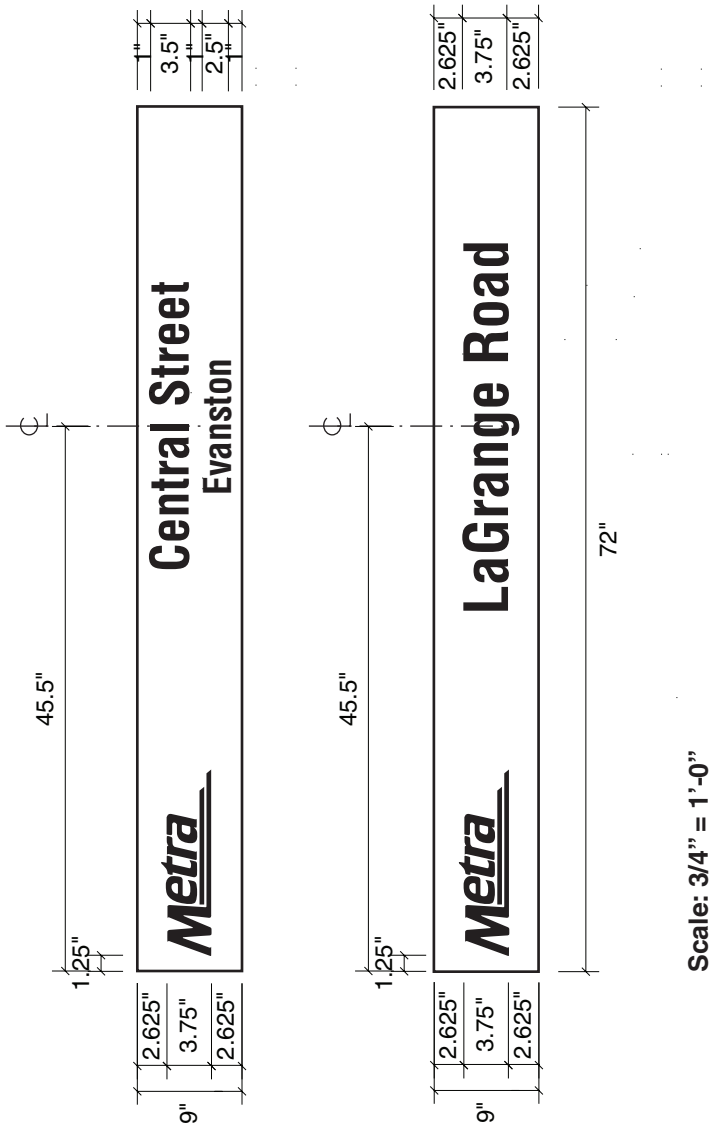
For Design Intent Only

SIGN TYPE 1F	Major Station Identifier with Amtrak Logo (12”H x 98.5”W) Specifications
Size:	12” H X 98.5” W
Material:	.125” Aluminum plate continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	One line condition - 4 1/2” Cap height on station name Two line condition - 4 1/2” Cap height on station name 3” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White


Central Street
Evanston
LaGrange Road
AMTRAK
Metra
White Logo
White Copy
Blue Background
98.5"
49.25"
1.25"
12"
1"
6"
2.5"
3"
1.5"
4.5"
3.75"

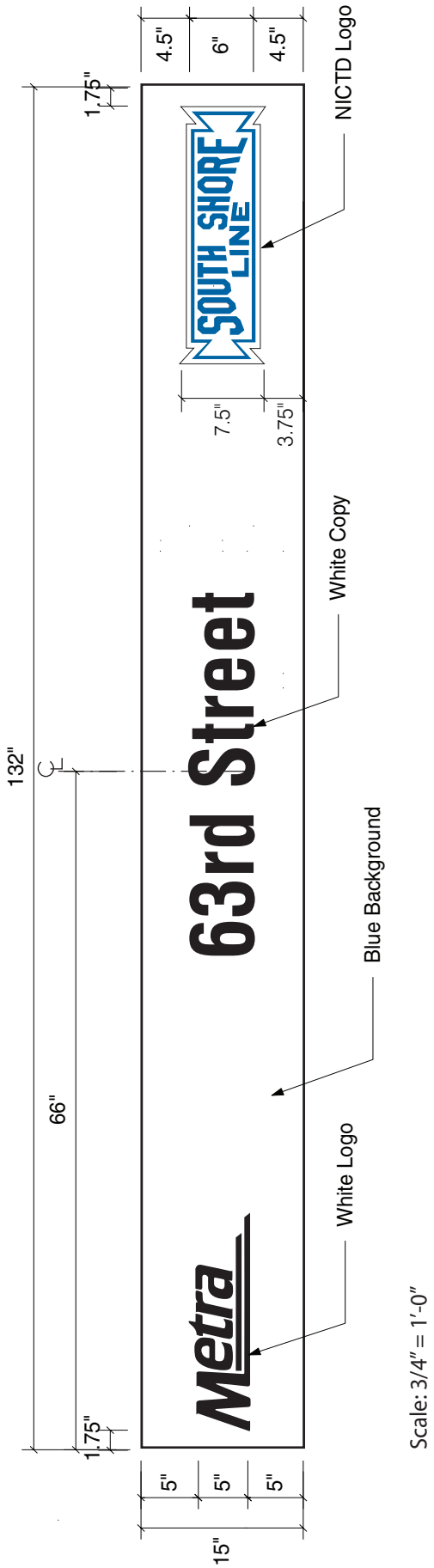
Scale: 3/4” = 1’-0”

SIGN TYPE 1G	Major Station Identifier (9”H x 72”W) Specifications
Size:	9” H X 72”W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	One line condition - 3 3/4” Cap height on station name Two line condition - 3 1/2” Cap Height on station name 2 1/2” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White


Central Street
Evanston
LaGrange Road
45.5"
1.25"
2.625"
3.75"
2.625"
9"
1"
3.5"
1"
2.5"
1"
72"

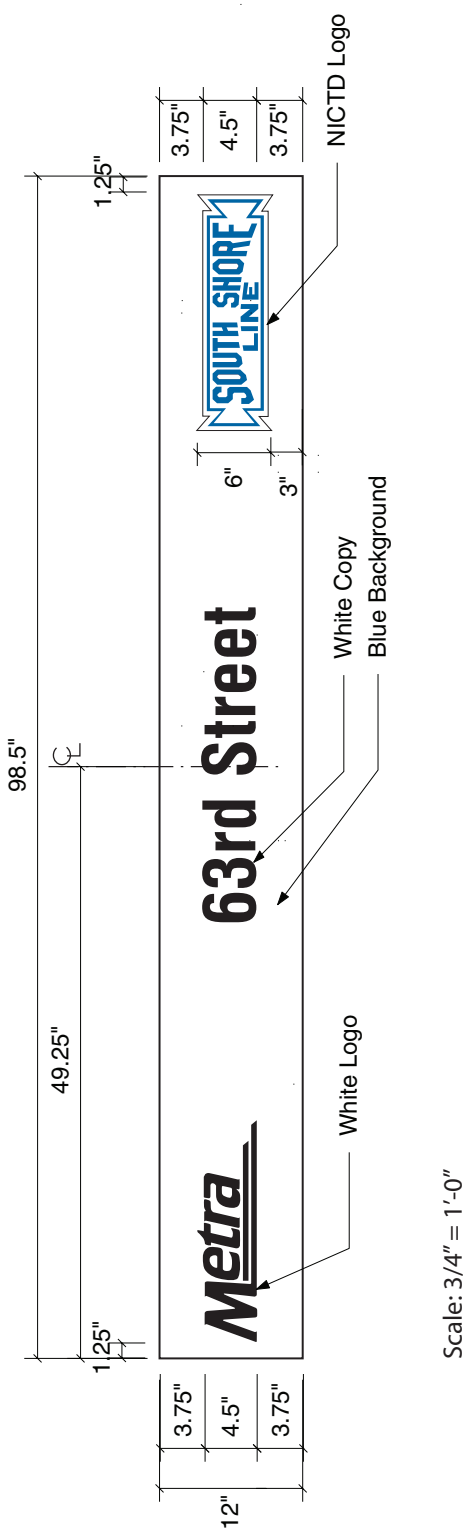
Scale: 3/4” = 1’-0”

SIGN TYPE 1H	Major Station Identifier with NICTD Logo (15”H x 132”W) Specifications
Size:	15” H X 132” W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case, Metra logo and NICTD logo
Copy Size:	6” Cap height on station name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White



For Design Intent Only

SIGN TYPE 1J	Major Station Identifier with NICTD Logo (12”H x 98.5”W) Specifications
Size:	12” H X 98.5” W
Material:	.125” Aluminum plate with continuous aluminum “C” channel (See details on page 37)
Finish:	Painted acrylic polyurethane w/UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case, Metra Logo, and NICTD Logo
Copy Size:	4 1/2” Cap height on station name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White


NICTD Logo
3.75"
4.5"
3.75"
1.25"
SOUTH SHORE LINE
6"
3"
98.5"
63rd Street
White Copy
Blue Background
49.25"
Metra
White Logo
1.25"
3.75"
4.5"
3.75"
12"
Scale: 3/4” = 1’-0”

Description:

These signs are used to identify stations for passengers who are riding or debarking trains. They include the station name and may also include a second line to indicate track directions (To or From Chicago). The signs double as track directionals primarily at stations where projected signs are most vulnerable to vandalism. These signs can be one - or two -sided.

Signs will be post mounted in most cases and will be spaced along platforms, parallel to the tracks. Whenever possible, they will straddle light poles to help visibility at night. Signs are generally mounted 18" - 24" behind the platform. They should not be mounted on the platform to avoid interference with snow plowing. These signs may also be used along tracks where there is no platform, but must be at least 8'- 6" from the center of the track. If one-sided, copy will be on the side facing the tracks. A strip of reflective tape is placed across the back of these signs to avoid the possibility of someone walking into the sign.

Sign panels must be able to be removed and replaced on-site for cost effective sign maintenance.

Mounting:

Mounting conditions include concrete, asphalt, dirt and wooden platforms. All signs to be capable of being mounted through concrete embedment, plates and anchor bolts. All post mounted signs to be supplied with all posts, plates, and bolts.

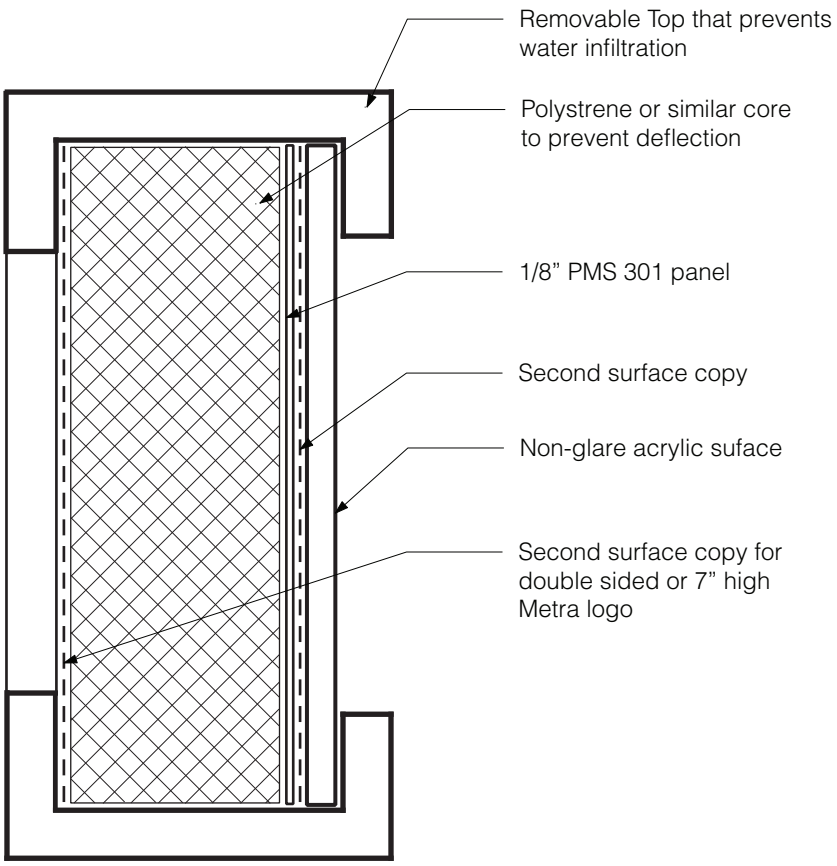
Concrete Embedment
Aluminum posts are typically embedded 3'-0" directly into concrete footings. Add the distance below grade to post length for direct burial mounting. Refer to mounting detail on page 245.

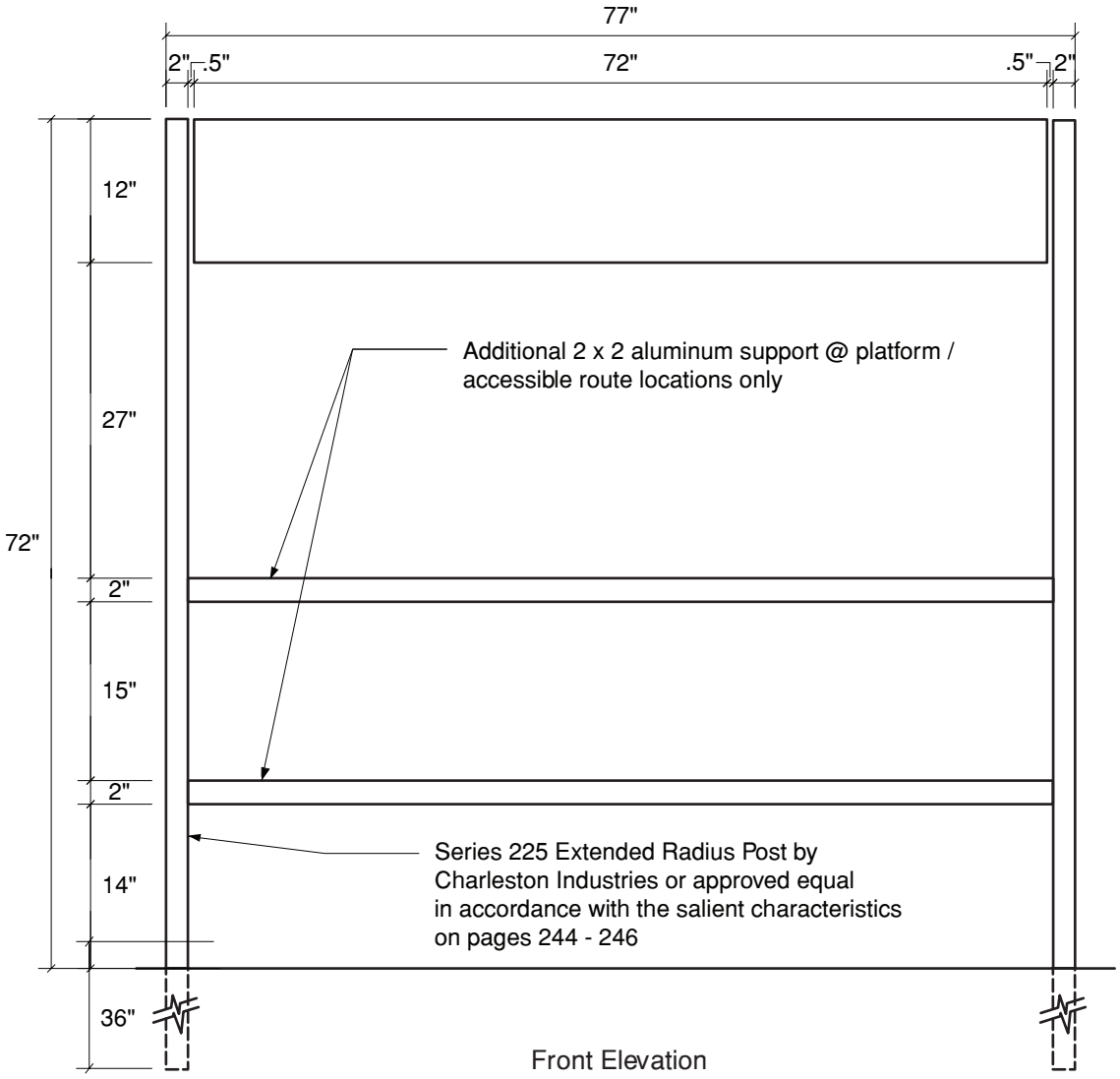
Plate and Bolt Mounted
Welded aluminum flange plates are mechanically fastened to J-bolts or anchor bolts embedded into concrete footings. Refer to mounting detail on page 246.

PLEASE NOTE: 2A sign posts may need additional support to provide extra protection from hazards such as vandalism, cars, etc. Metra will determine if additional support is needed on a per station basis.

Following are specifications and schematics for Type 2 signs.

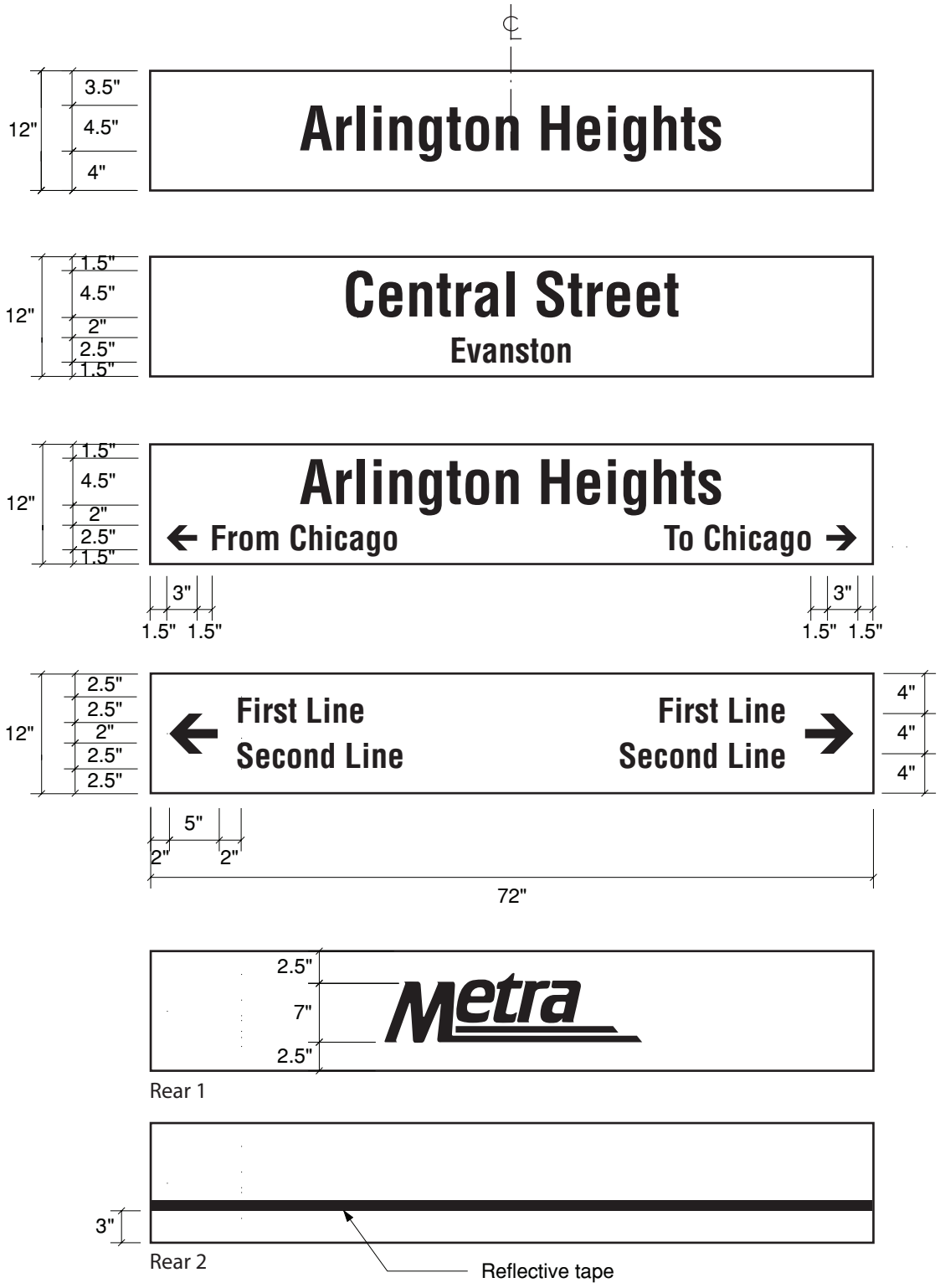
Post Height:	72” H from platform surface to top of post.
Post Material:	2” X 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics on pages 244 - 246. (See page 62 for post design in an accessible path).
Post & Reveal Color:	Black anodized finish
Panel Size:	12”H X 72”W
Frame Material:	Sign Panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather resistant.
Frame Finish:	Painted acrylic polyurethane w/UV inhibitors, Eggshell finish (11-19) degree gloss on 60 degree glossimeter). 1” reflective tape on back of sign - 1 1/2” from bottom edge.
Frame Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters applied to the second surface (sub surface) of a 1/8” non- glare polycarbonate face panel. Background color shall be PMS 301.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Sze:	4 1/2” Cap height on station name 2 1/2” Cap height on smaller line
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol:	Parallel tip arrow, Metra logo on back of sign (as directed by Metra)
Symbol Size:	2 1/2” H
Symbol Color:	White

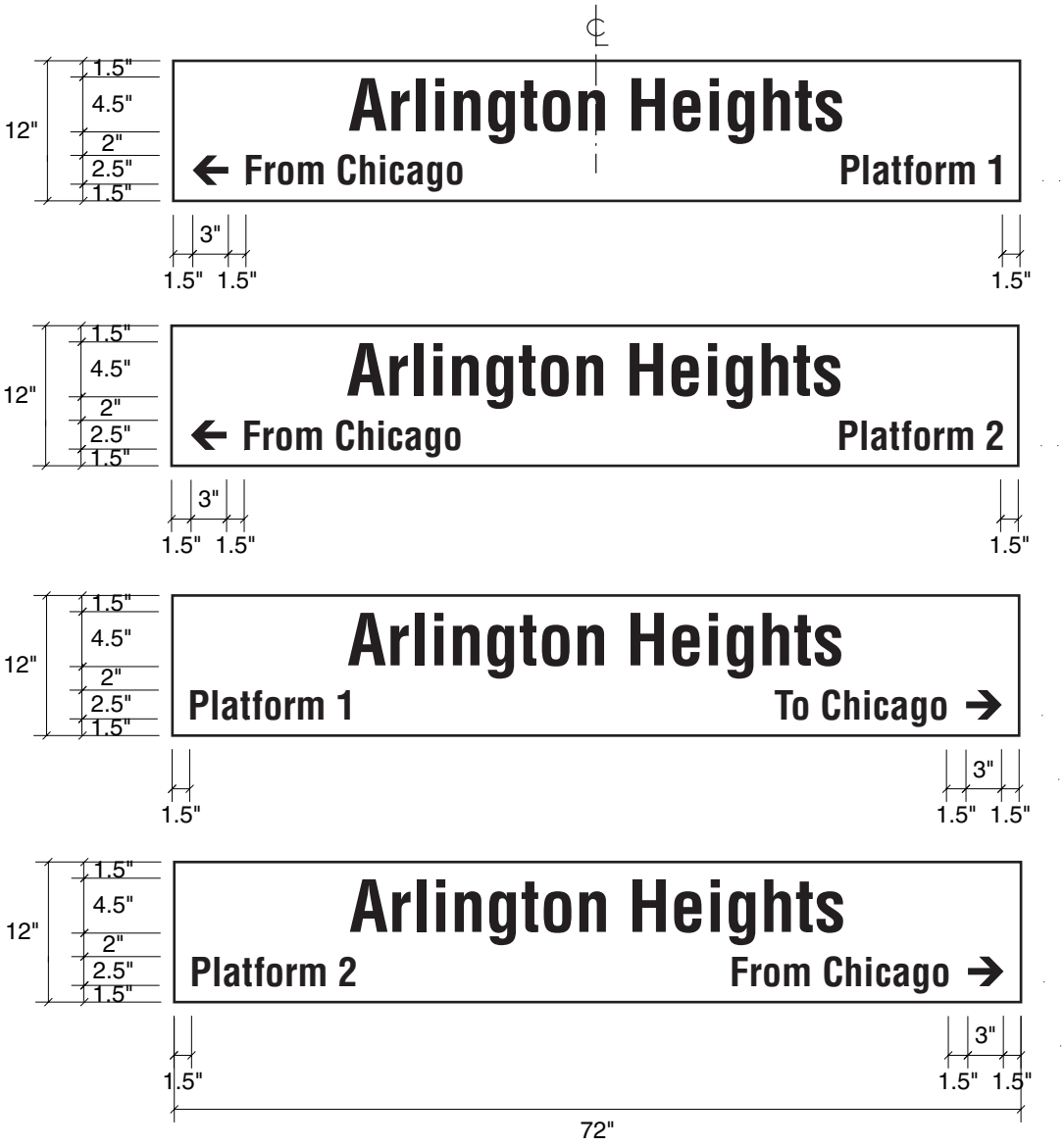

Removable Top that prevents water infiltration
Polystrene or similar core to prevent deflection
1/8” PMS 301 panel
Second surface copy
Non-glare acrylic suface
Second surface copy for double sided or 7” high Metra logo



Front Elevation

Scale: 3/4” = 1’-0”


Arlington Heights
12"
3.5"
4.5"
4"
Central Street
Evanston
1.5"
2"
2.5"
Arlington Heights
From Chicago
To Chicago
3"
First Line
Second Line
5"
72"
Metra
7"
Rear 1
Rear 2
Reflective tape


Arlington Heights
From Chicago
Platform 1
Arlington Heights
From Chicago
Platform 2
Arlington Heights
Platform 1
To Chicago
Arlington Heights
Platform 2
From Chicago
12"
1.5"
4.5"
2"
2.5"
1.5"
3"
72"

Scale: 3/4” = 1’-0”

Description:

These signs provide helpful travel information for commuters at the station site. The “3A” consists of a Header Panel across the top which says “Information” (or in select cases , the station name); an Information Panel in the center which contains the Metra logo, addresses, phone numbers and maps; and two enclosed Display Boards (bulletin boards) on either side of the information panel. Information such as train schedules will be displayed and updated in these bulletin boards.

The display boards will have doors that swing open (from top) and must be weatherproof to avoid water leakage and condensation that can damage the interior of the bulletin board as well as the posted materials. All doors must be locked using the same key. The sign should be constructed so that the doors can be replaced without replacing the entire display board. The polycarbonate panel and tackboard should be able to be removed and replaced easily, on site without taking the entire sign apart.

The second version of this sign, “3B”, has only one display board, located to one side of the Information Panel.

The third version of the sign, “3C,” is a more current type of sign which contains all the information in a different manner. See detailed specifications and schematics for further information.

Type 3C

Size:	30 1/4”x41 3/4”
Material:	13 gauge, stainless steel frame with 1/4” white acrylic backing and 3/16” clear polycarbonate face and screws per details shown on page 72. Stainless steel frames shall be brushed finished with passive coating.
Mounting Height:	48” from finished grade to bottom of sign .

Type 3D

Size:	22 1/2”x23 1/2”
Material:	13 gauge stainless steel frame with 1/4” white acrylic backing and 3/16” clear polycarbonate face and screws per details shown on page 73. Stainless steel frames shall be brushed finished with passive coating.
Mounting Height:	48” from finished grade to bottom of sign.

Type 3E

Size:	22 1/2”x23 1/2”x1/4”
Material:	Clear acrylic frame with routed edges, silk screened 2nd surface, one inch black border per details shown on page 74.
Mounting Height:	48” from finished grade to bottom of sign.

Type 3F

Size:	14 1/2”x11”x1/4”
Material:	Clear acrylic frame with routed edges, silk screened 2nd surface, one inch black border per details shown on page 75.
Mounting Height:	Varies

One sign will be located at each station, usually near the main building area and parallel to the tracks. Signs may be posted or wall mounted, depending on station conditions. Where possible, the sign will be positioned under an eave or roof for protection.

Mounting:

All signs must be capable of being mounted through concrete embedment, plates and anchor bolts, and wall mounting. All posts and wall mounted signs are to be supplied with all posts, plates, bolts, and/or end caps.

Concrete Embedment

Aluminum posts are typically embedded 42” directly into concrete footings. Add the distance below grade to post length for direct burial mounting.

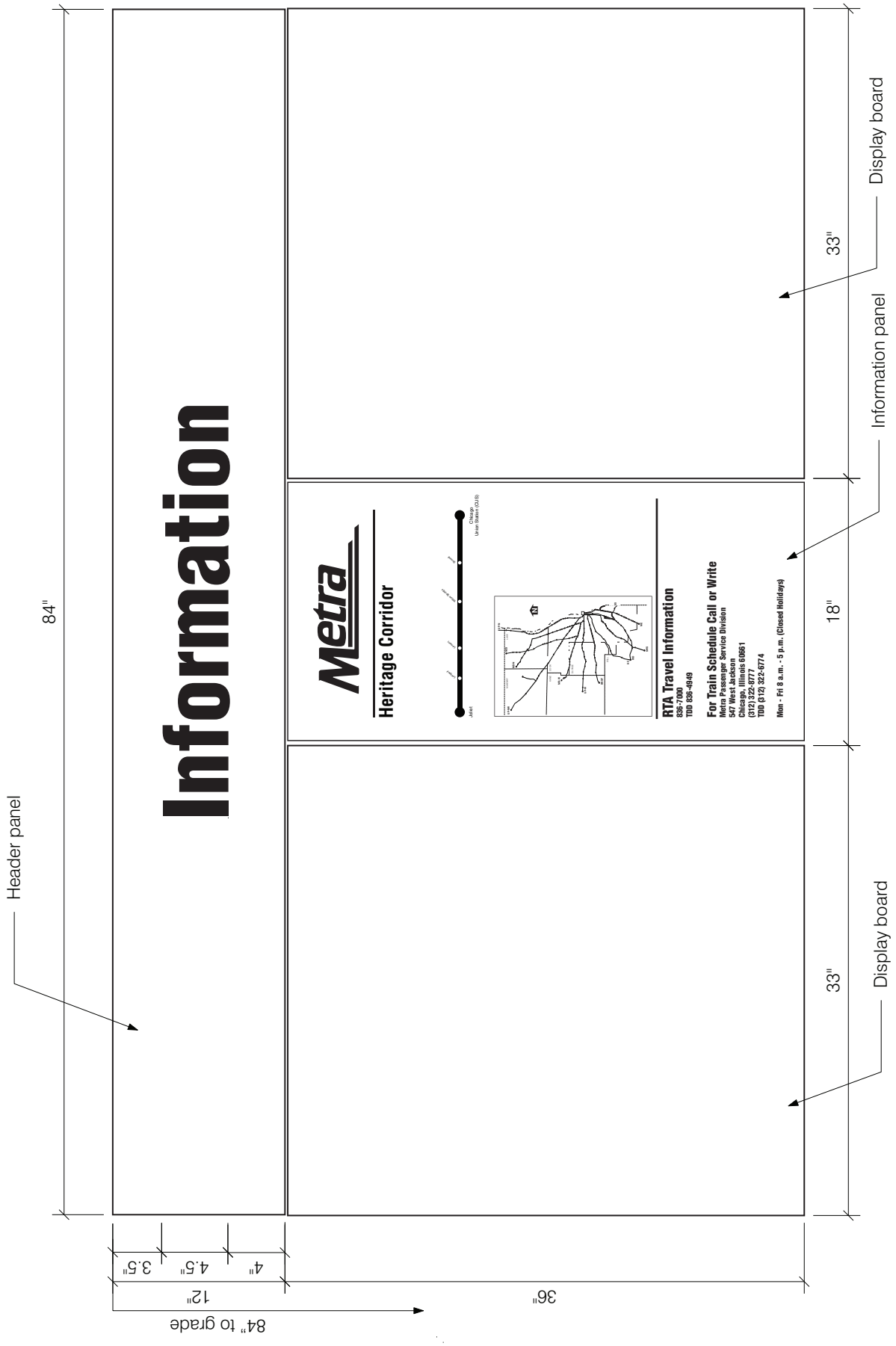
Plate and Bolt Mounted

Welded aluminum flange plates are mechanically fastened to J-bolts or anchor bolts embedded into concrete footings.

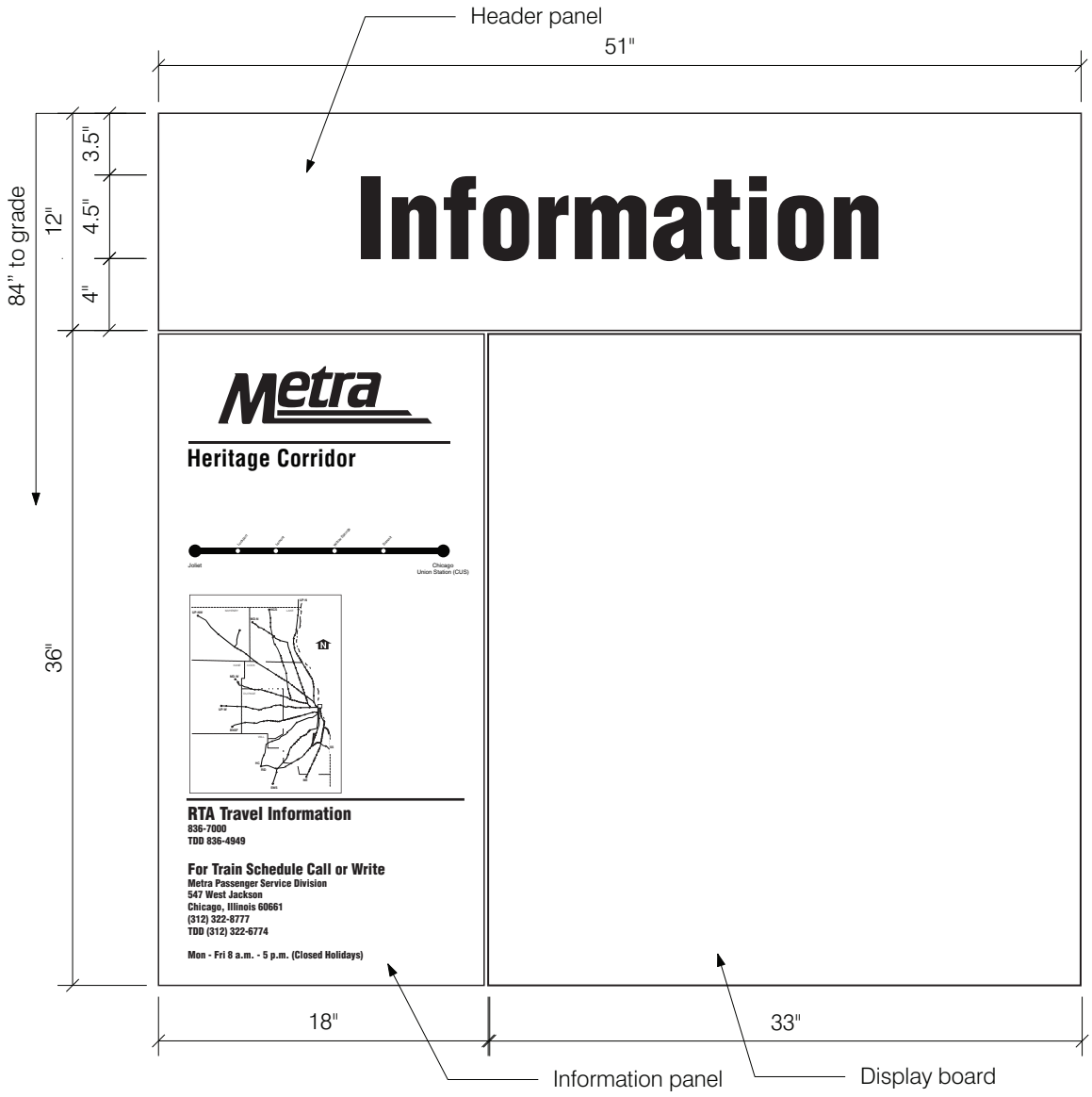
Wall Mounted

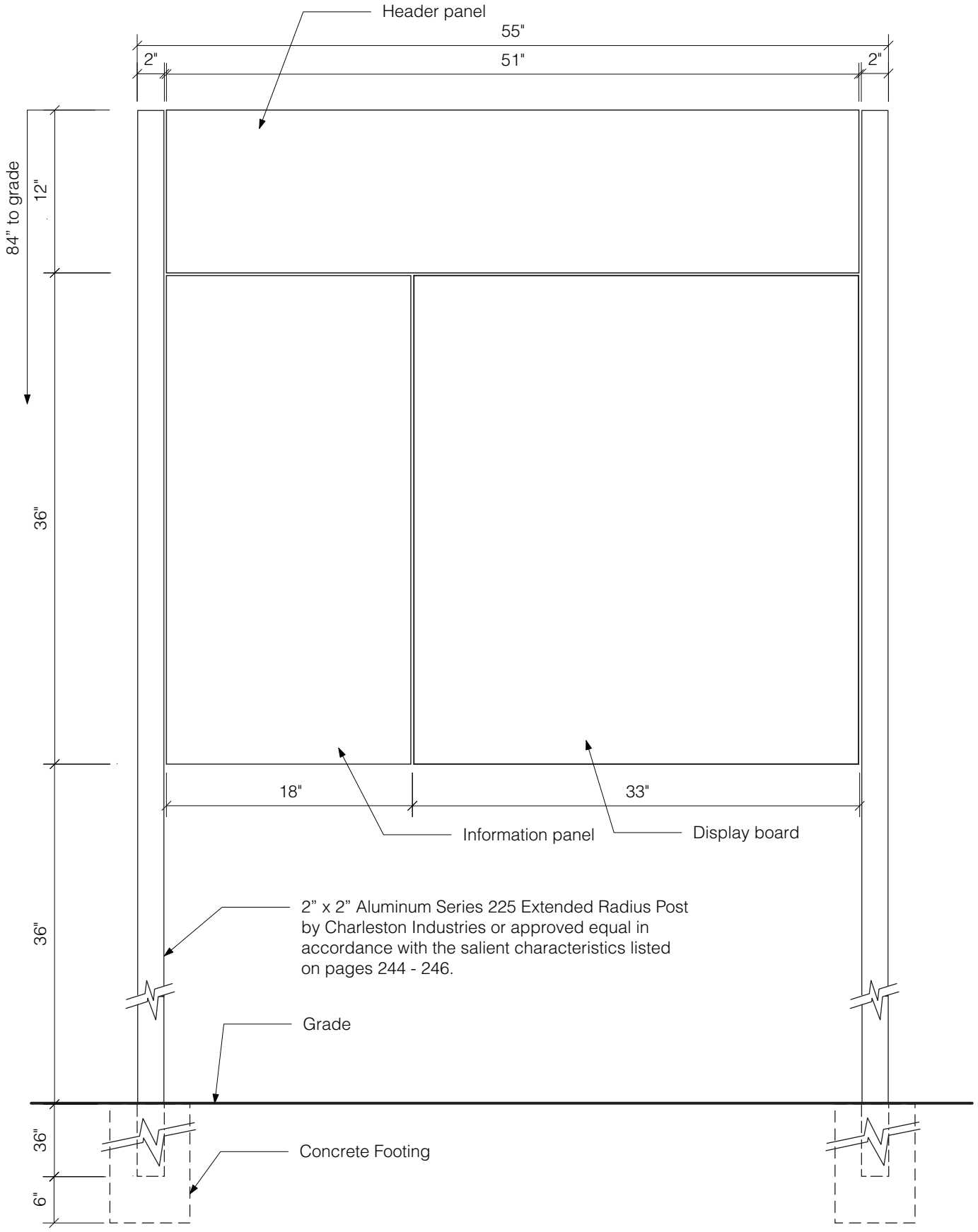
Extruded aluminum end sections are mechanically fastened to wall with anchor bolts.

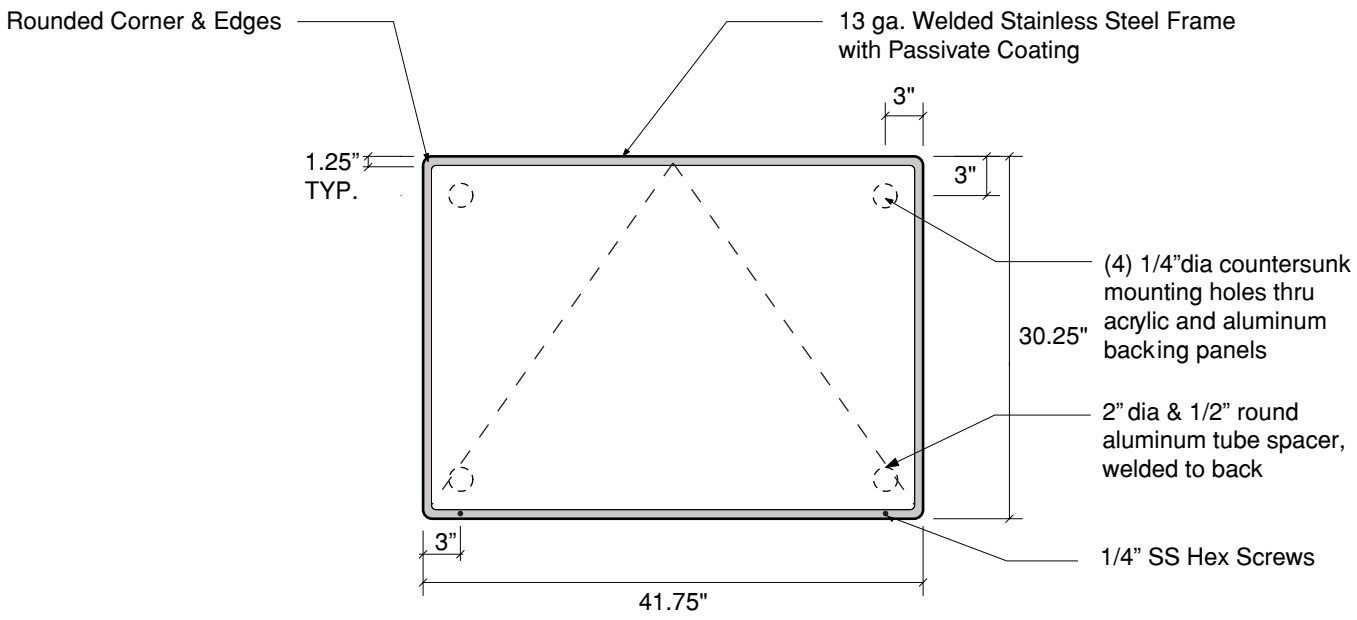
SIGN TYPE 3A	Large Information Display Board Specifications
Post Height:	84” from Grade
Post Material:	2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics listed on pages 244 - 246.
Post & Reveal Color:	Black anodized finish
Header Panel Size:	12” H x 84” W
Information Panel/ Display Board Size:	36” H x 84” W: 2 Display boards - 36” H x 33” W each 1 Information panel 36” H x 18” W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant. 2” thick non-illuminated display board cabinet with polycarbonate faces and weatherproofed. Synthetic tackboard - water-resistant and sunrot / fade-resistant
Finish:	Painted acrylic polyurethane w/ UV inhibitors Eggshell finish (11 - 19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	1/8” non-glare polycarbonate face panel. Background color shall be PMS 301
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	4 1/2” Cap height on information header Copy height varies on graphic panel (See layout specifications)
Letterform Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy color:	White


Information
Metra
Heritage Corridor
RTA Travel Information
836-7000
TDD 836-4949
For Train Schedule Call or Write
Metra Passenger Service Division
547 West Jackson
Chicago, Illinois 60661
(312) 322-8777
TDD (312) 322-6774
Mon - Fri 8 a.m. - 5 p.m. (Closed Holidays)
Header panel
Information panel
Display board
Display board
84"
33"
18"
33"
36"
12"
84" to grade
4"
4.5"
3.5"

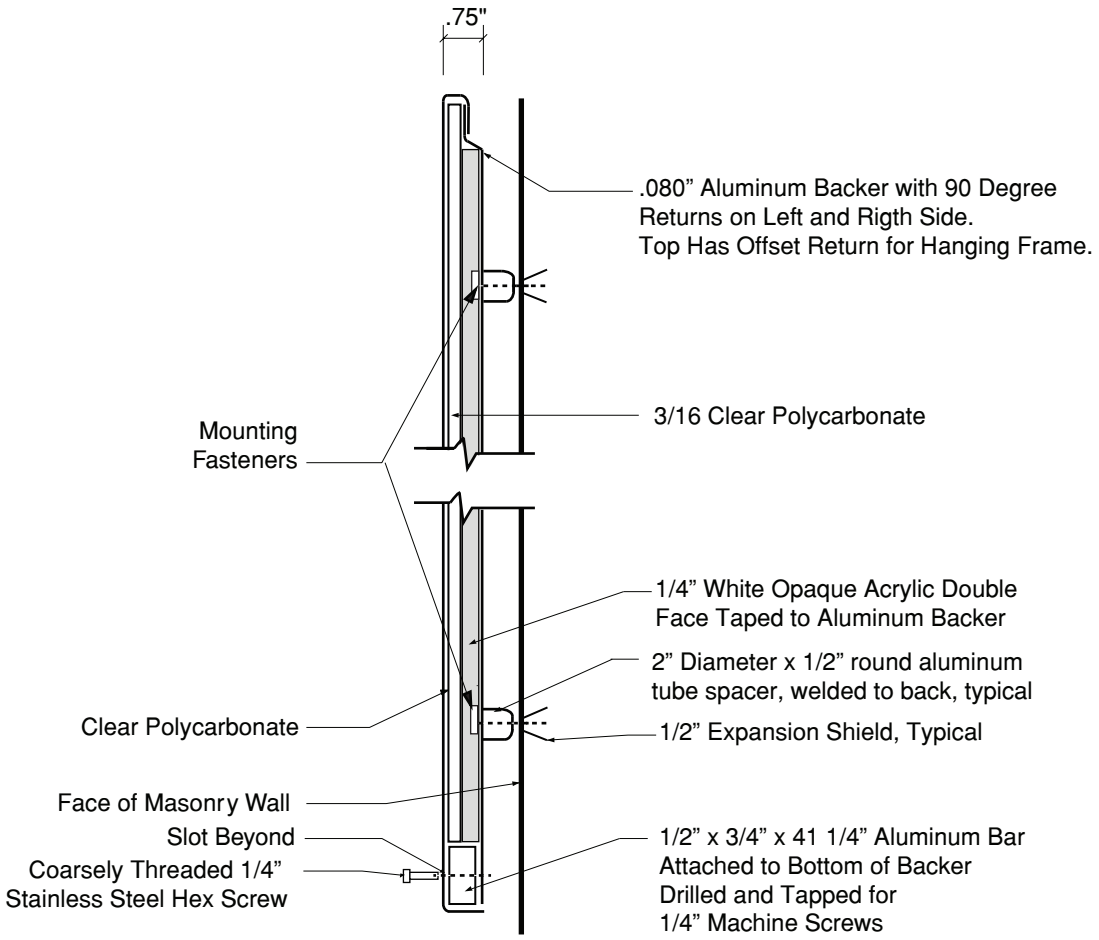
SIGN TYPE 3B	Small Information Display Board Specifications
Post Height:	84” from Grade
Post Material:	2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics listed on pages 244 - 246.
Post & Reveal Color:	Black anodized finish
Header Panel Size:	12” H x 51” W
Information Panel/ Display Board Size:	36” H x 51” W: 1 Display boards - 36” H x 33” W each 1 Information panel 36” H x 18” W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant. 2” thick non-illuminated display board cabinet with polycarbonate faces and weatherproofed. Synthetic tackboard - water-resistant and sunrot / fade-resistant=
Finish:	Painted acrylic polyurethane w/ UV inhibitors Eggshell finish (11 - 19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	1/8” non-glare polycarbonate face panel. Background color shall be PMS 301
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	4 1/2” Cap height on information header Copy height varies on graphic panel (See layout specifications)
Letterform Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy color:	White


Header panel
51"
84" to grade
12"
3.5"
4.5"
4"
Information
Metra
Heritage Corridor
Joliet
Chicago
Union Station (CUS)
36"
RTA Travel Information
836-7000
TDD 836-4949
For Train Schedule Call or Write
Metra Passenger Service Division
547 West Jackson
Chicago, Illinois 60661
(312) 322-8777
TDD (312) 322-6774
Mon - Fri 8 a.m. - 5 p.m. (Closed Holidays)
18"
33"
Information panel
Display board


Header panel
55"
2"
51"
2"
84" to grade
12"
36"
18"
33"
Information panel
Display board
2" x 2" Aluminum Series 225 Extended Radius Post
by Charleston Industries or approved equal in
accordance with the salient characteristics listed
on pages 244 - 246.
36"
Grade
36"
Concrete Footing
6"

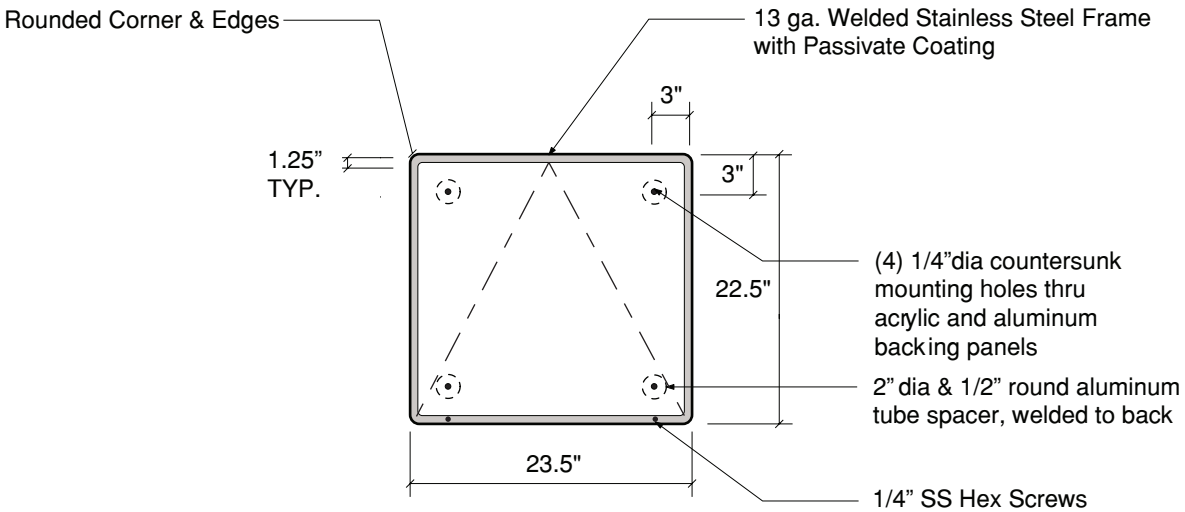


Scale: NTS

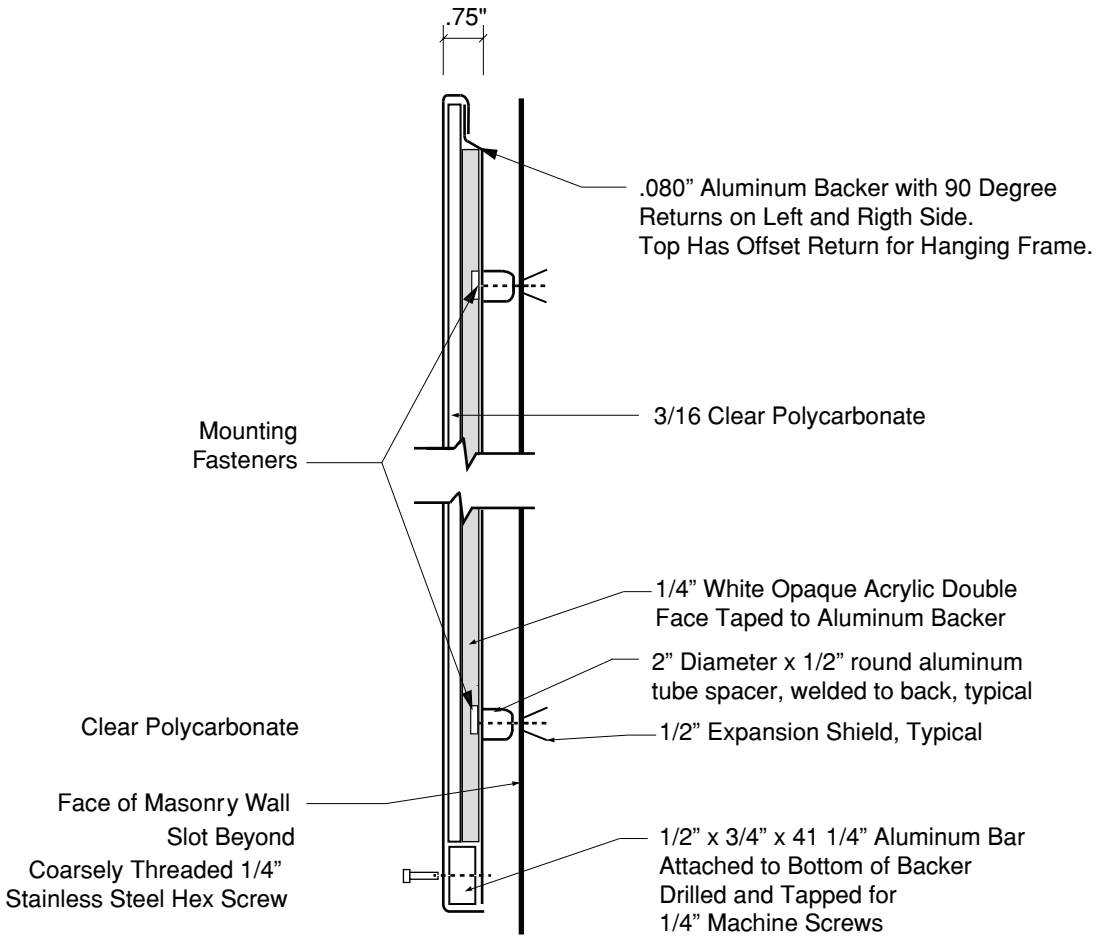


Section Thru Stainless Steel Frame

Scale: NTS



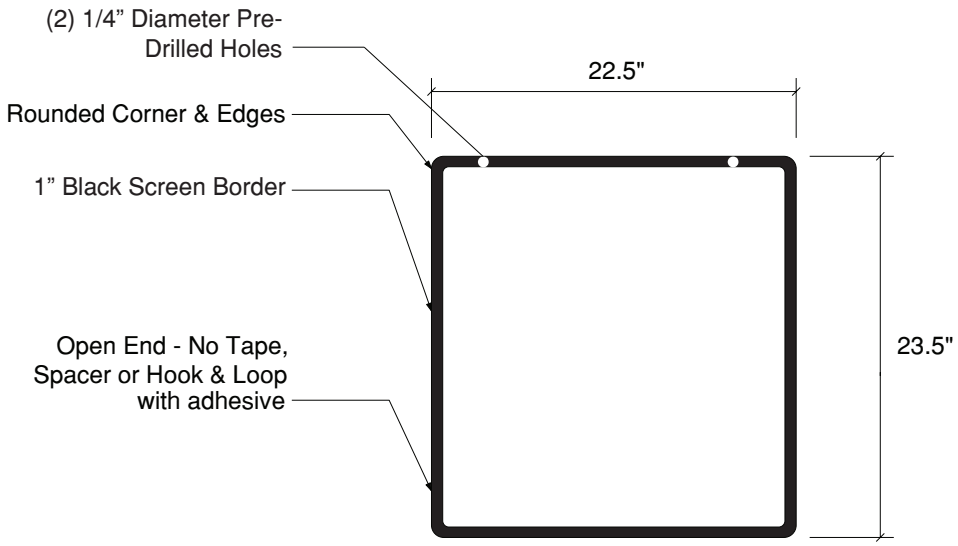
Scale: NTS



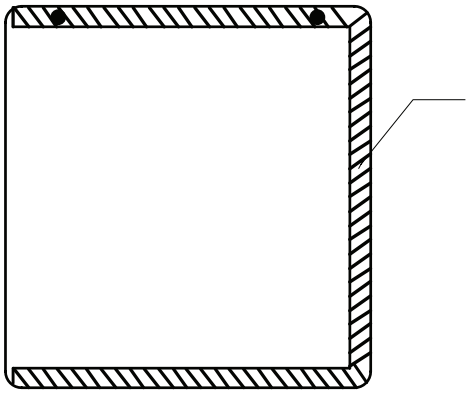
Section Thru Stainless Steel Frame

Scale: NTS

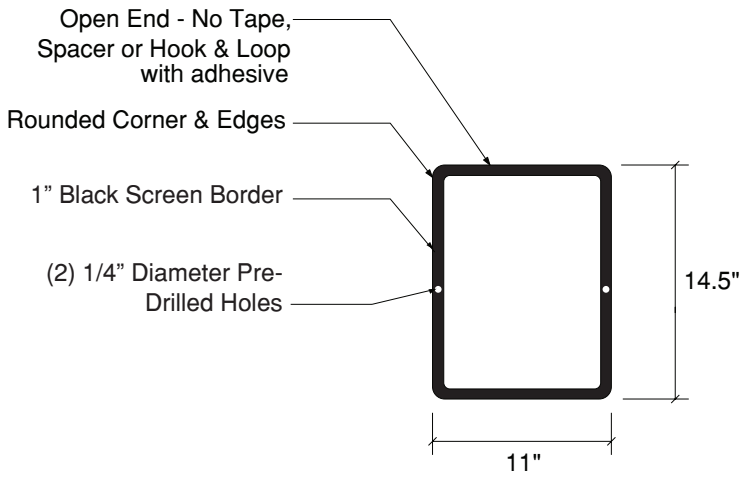
For Design Intent Only



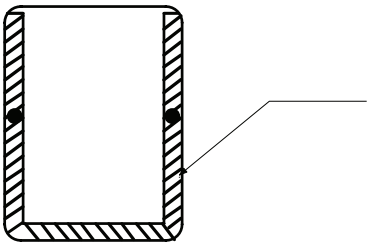
Front View
Scale: 1”= 1’-0”



RearView
Scale: 1”= 1’-0”



Front View
Scale: NTS



Rear View
Scale: 1”=1’-0”

Description:

The purpose of these signs is to identify and direct commuters to bus stop, taxis, parking and accessible entrances, exits, ramps, etc. The base sign (24"H x 18" W) is used as an identification sign. A separate panel with an arrow (12"H x 18"W) can be added underneath the base sign to become a directional sign. A separate panel can also be added to carry secondary messages, such as listing of bus routes. When both message and arrow panels are used, the arrow will be last. No more than two additional panels may be added to a base sign.

Mounting:

All sign panels, including the arrow and message panels, slide and lock into posts. Panels must be capable of being removed and replaced on site to keep maintenance and replacement costs to a minimum.

Concrete Embedment
Aluminum posts are typically embedded 3 ft. directly in concrete footings. Add the distance below grade to post length for direct burial mounting.

Plate and Bolt Mounted
Welded aluminum flange plates are mechanically fastened to J-bolts or anchor bolts embedded into concrete footings.

Wall Mounted
Extruded aluminum end sections are mechanically fastened to wall with anchor bolts.

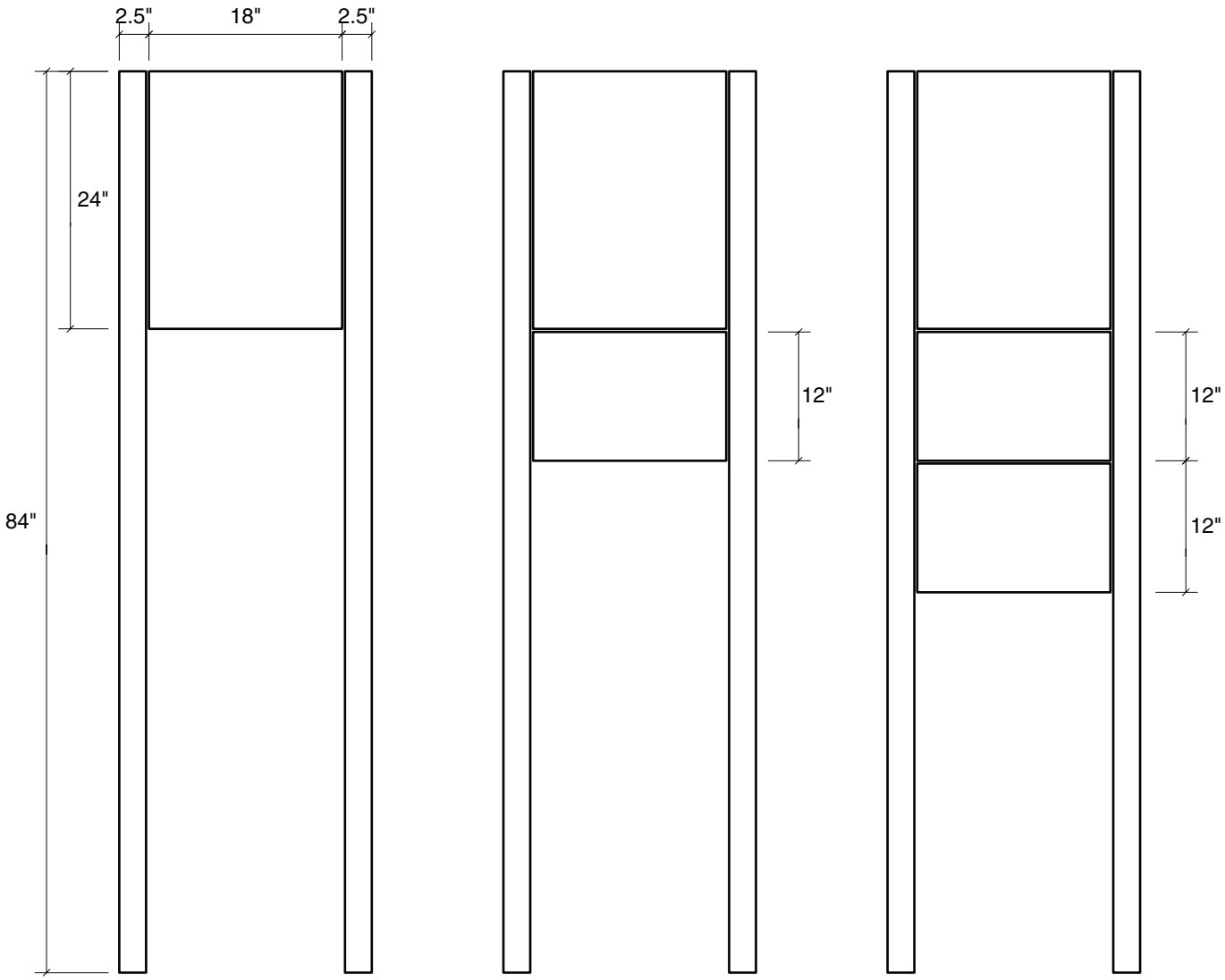
Following are standard sign messages and schematics for Type 4 signs. Custom messages can also be accommodated.

Sign Type

4.1	(Symbol) Bus Stop
4.2	(Symbol) Taxi
4.3	(Symbol) Kiss 'N Ride
4.3a	(Symbol)(Symbol) Kiss 'N Ride
4.4	(Symbol) Commuter Parking
4.5	(Symbol) Entrance
4.6	(Symbol) To Trains (Arrow)
4.7	(Symbol) Ramp To Chicago (Arrow)
4.8	(Symbol) Ramp From Chicago (Arrow)
4.9	(Symbol) Ramp To Trains (Arrow)
4.10	Not Used
4.11	Not Used
4.12	Not Used
4.13	(Symbol) Notice! Some trains board on center track. Please refer to train schedule.
4.14	(Symbol) Accessible Boarding Rush-Hour
4.15	(Symbol) Accessible Boarding Non-Rush
4.16	(Symbol) Accessible Boarding
4.0	(Custom)

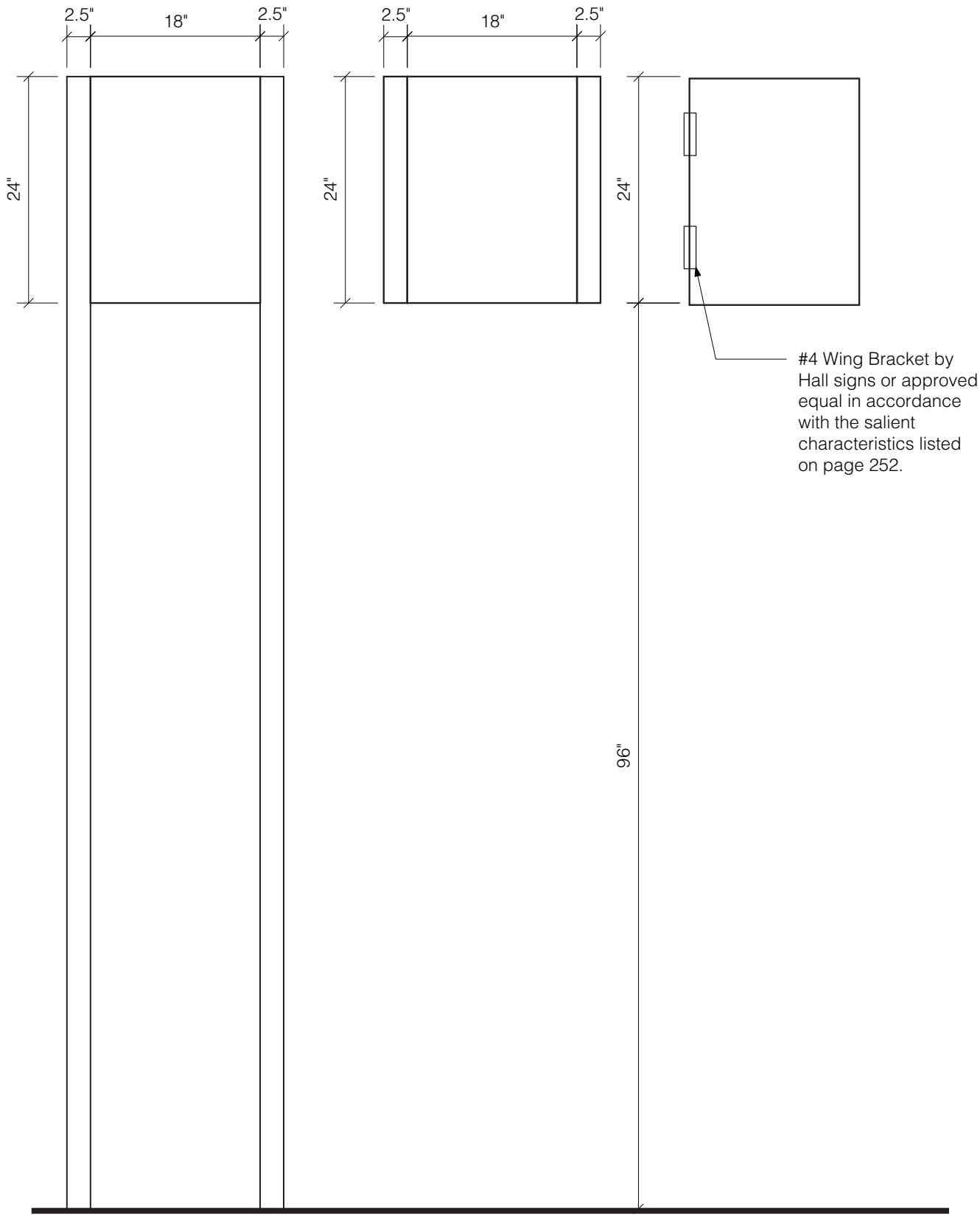
SIGN TYPE 4	Primary Identification / Directional Specifications
Post Height:	84” from grade to top of sign
Post Material:	2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal (see page 244 - 246 for details)
Post & Reveal Color:	Black anodized finish
Panel Size:	24”H x 18”W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant.
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	2 1/2” cap height - one or two line condition 2” cap height - three line condition Sign Type 4.0, custom message varies
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol:	Varies (see graphic details)
Symbol Size:	9”
Symbol Color:	White

SIGN TYPE 4	Primary Identification / Directional (Lower Panel) Specifications
Panel Size:	12”H x 18”W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant.
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Symbol:	1 Arrow Panel - parallel tip Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Symbol Size:	6”
Symbol Color:	White
Letterform:	2 Message Panel - Helvetica Bold Condensed Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Size:	Varies
Copy Color:	White



Identification **Directional** **Custom Message with Directional**

Scale: 3/4” = 1’-0”

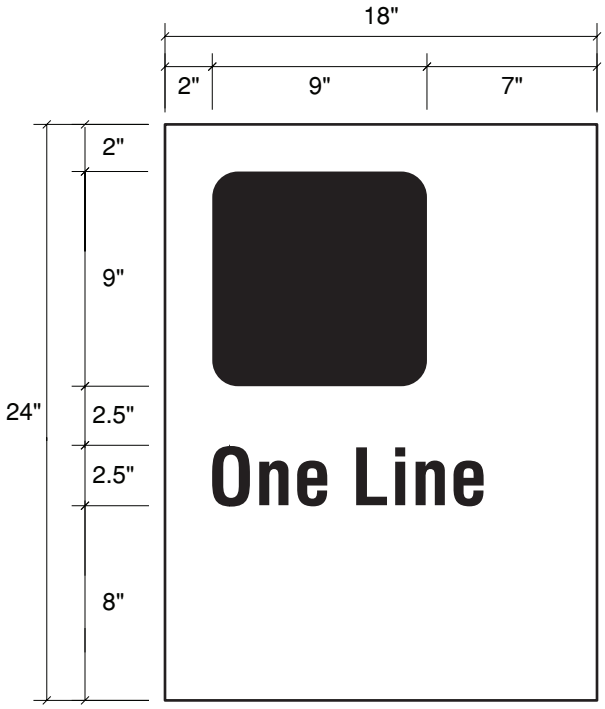


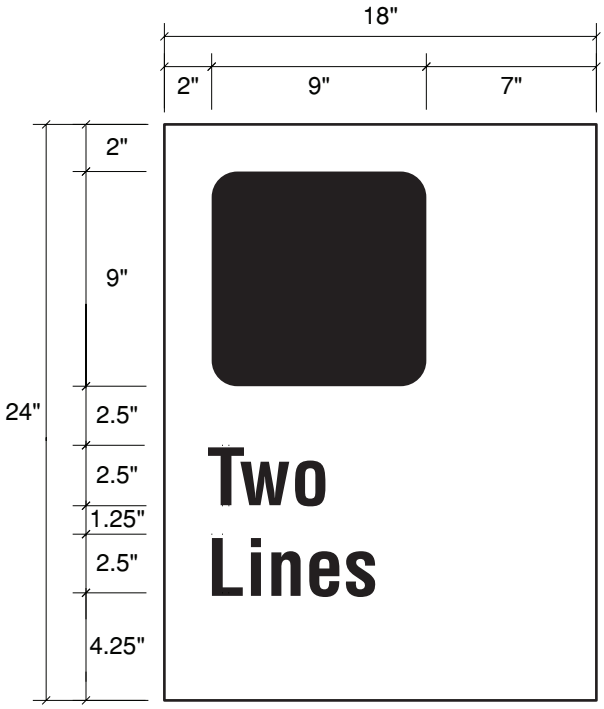
Post Mount
for 4.14, 4.15 & 4.16
(Copy size: 3” High Min.)

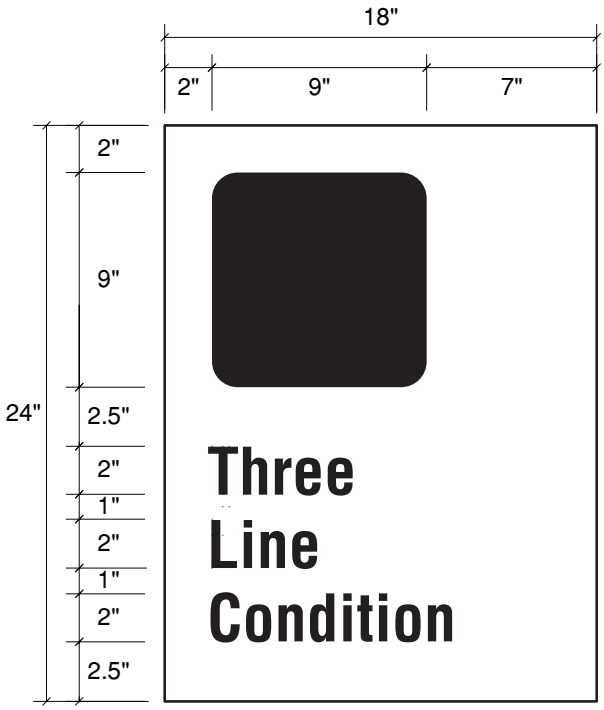
Flush Mount with Post

Projecting Mount
(Copysize: 3” High, Min.)

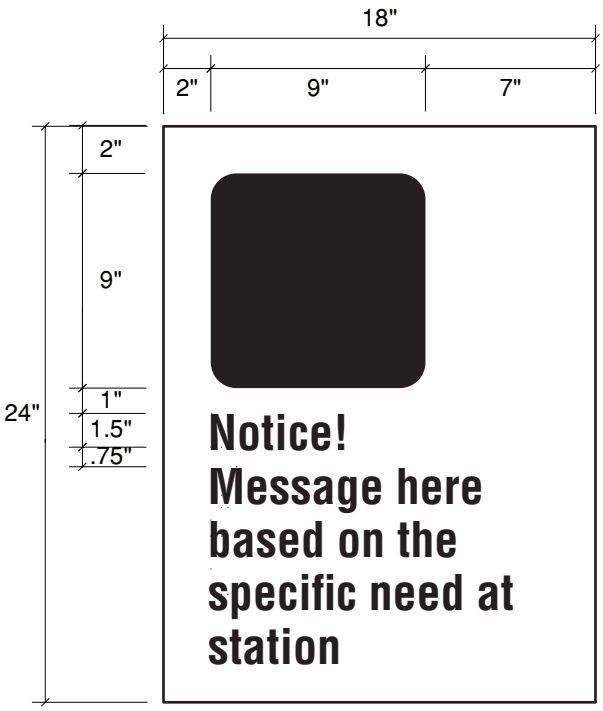
For Design Intent Only

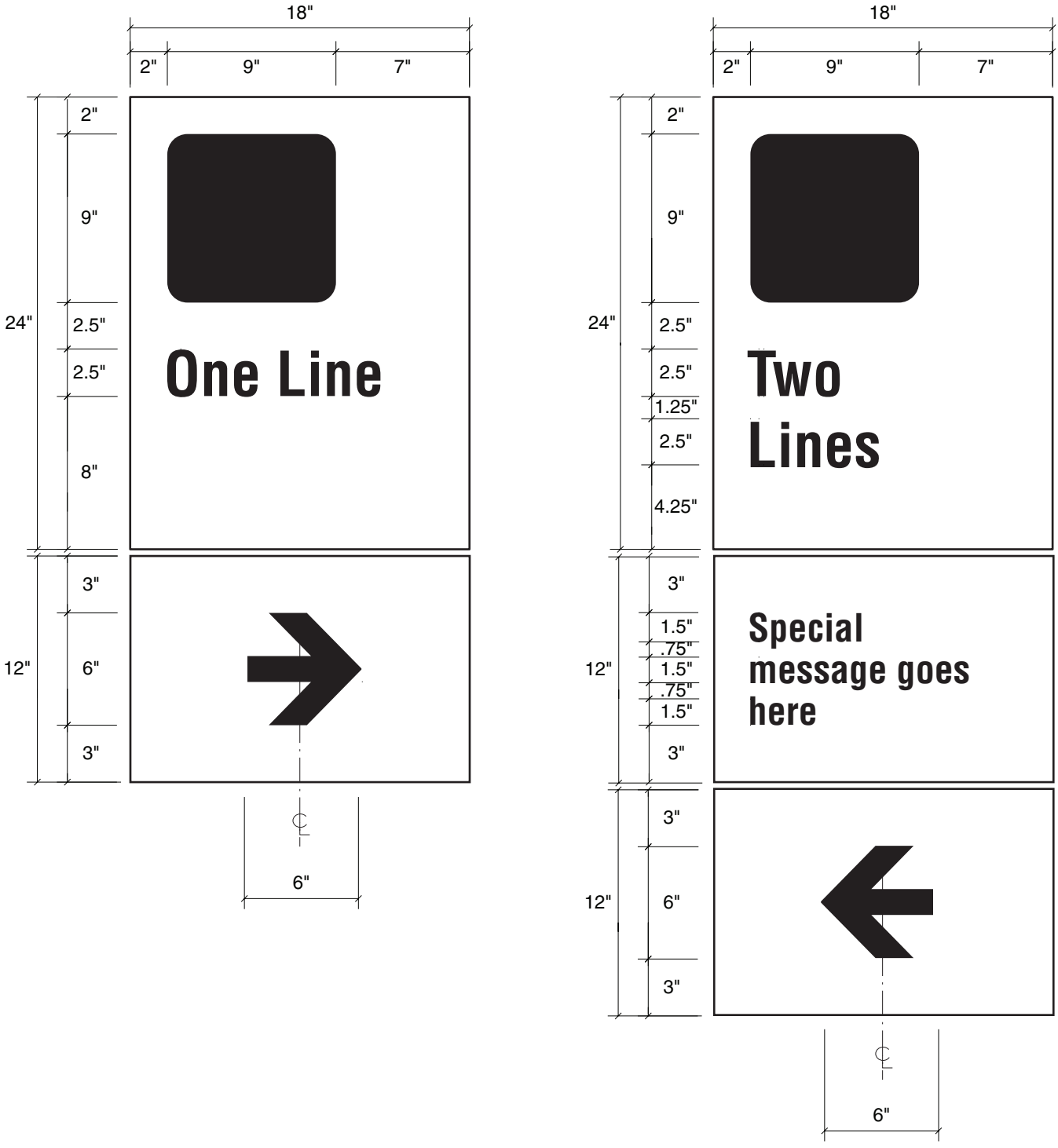




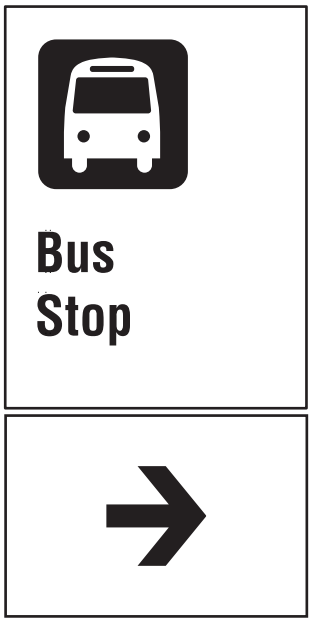


Note: This format is also used for signs with long words that will not fit using 2.5" type

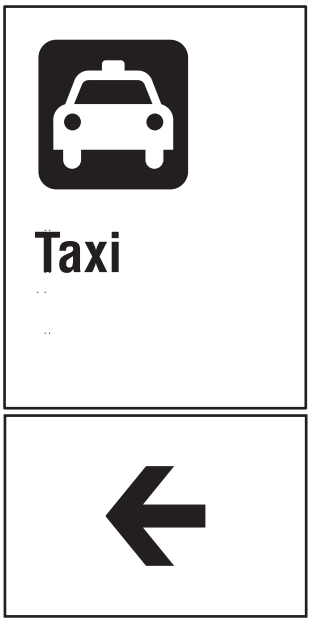



18"
2"
9"
7"
2"
9"
2.5"
2.5"
8"
24"
3"
6"
3"
12"
One Line
6"
18"
2"
9"
7"
2"
9"
2.5"
2.5"
1.25"
2.5"
4.25"
24"
3"
1.5"
.75"
1.5"
.75"
1.5"
3"
12"
Two Lines
Special message goes here
3"
6"
3"
12"
6"

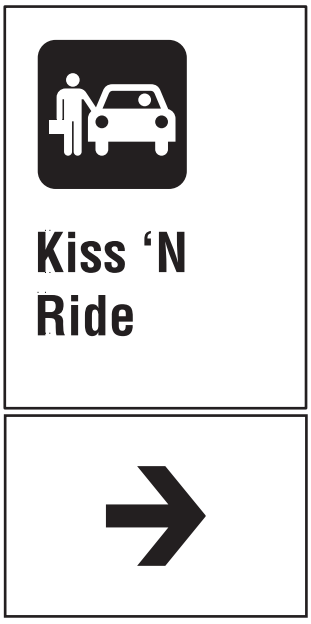
Scale: 1 1/2” = 1’-0”



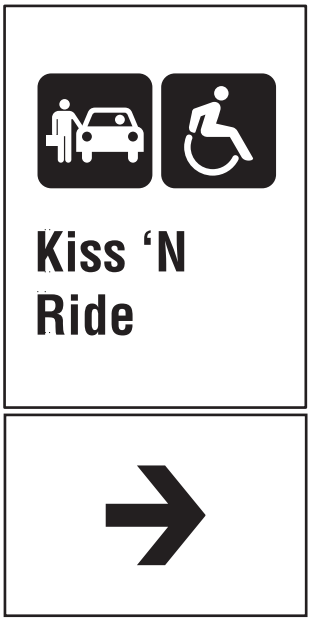
Sign Type 4.1
Used to identify and direct commuters to bus stops



Sign Type 4.2
Used to identify and direct commuters to taxis

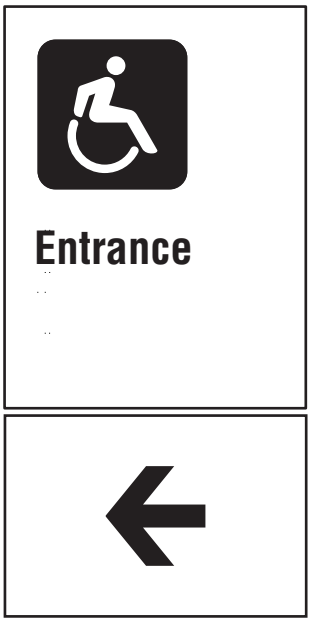


Sign Type 4.3
Used to identify and direct commuters to Kiss ‘N Ride

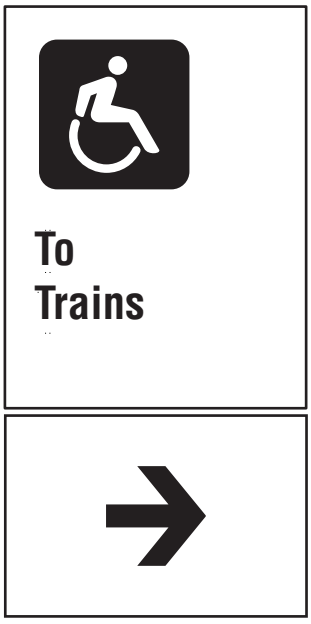


Sign Type 4.3a
Used to identify accessible Kiss ‘N Ride drop off

Sign Type 4.4
Used to identify and direct commuters to parking



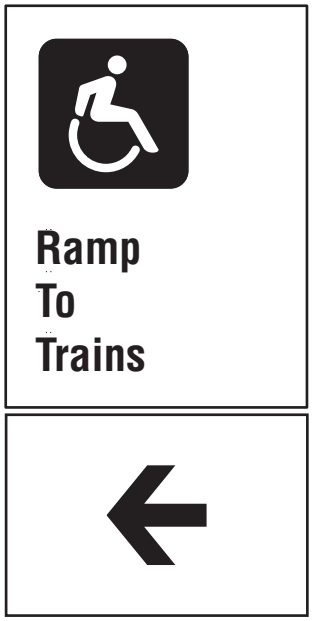
Sign Type 4.5
Used to direct disabled commuters to accessible entrances.



Sign Type 4.6
Used to direct disabled commuters to ramps to trains.

Sign Type 4.7
Used to direct disabled commuters to ramps to trains that are head to Chicago.

Sign Type 4.8
Used to direct disabled commuters to rampe to trains that are coming from Chicago.



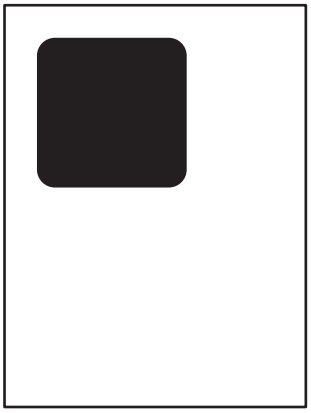
Sign Type 4.9
Used to direct disabled commuters to ramp to trains.

Sign Type 4.13
Used to alert commuters that all trains may not board from usual platforms

Sign Type 4.14
Used to direct disabled commuters to accessible boarding during rush hours (Post mounted. See page 81 for mounting detail)

Sign Type 4.15
Used to direct disabled commuters to accessible boarding during non-rush hours (Post mounted. See page 81 for mounting detail)

Sign Type 4.16
Used to direct disabled commuters to accessible boarding (Post mounted. See page 81 for mounting detail)



Sign Type 4.0
Used for custom messages.

Description:

The purpose of these signs is to identify and direct commuters to bus stops , taxis, proper platforms and accessible entrances, exits, ramps, etc. and to direct commuters to accessible phones and restrooms. These smaller signs are used when the larger Type4 signs are not appropriate.

Mounting:

All signs are capable of being mounted by two methods - projecting and flush. Projecting signs may be mounted to an existing post on the site , such as a light post , telephone pole etc. Materials and shapes of these posts may vary. If there is no existing post, the standard black anodized aluminum post will be utilized.

When a directional sign is projecting, such as To/From Chicago signs, the sign shall flag in the direction of the arrow whenever possible.

Flush mounted signs are to use tamper proof hardware painted out to match face of sign.

Following are specifications, standard sign messages and schematics for Type 5 signs. Custom messages can also be accommodated.

Sign Type 5:

5.1 (Symbol)(Optional Arrow)
Bus
Stop

5.2 (Symbol)(Optional Arrow)
Taxi

5.3 (Arrow)
To
Trains

5.4 (Arrow)
To
Chicago

5.5 (Arrow)
From
Chicago

5.6 (Symbol)(Arrow)
To
Chicago

5.7 (Symbol)(Arrow)
From
Chicago

5.8 (Symbol)(Arrow)
To
Trains

5.9 (Symbol)(Arrow)
Ramp To
Trains

5.10 (Symbol)(Arrow)
Ramp To
Chicago

5.11 (Symbol)((Arrow)
Ramp From
Chicago

5.12 (Symbol)(Symbol)(Arrow)
Restrooms

5.13 (Symbol)(Arrow)
Telephone

Sign Type 5 (Continued)

5.14 (Symbol)(Symbol)(Arrow)
Telephone

5.15 (Symbol)(Arrow)
Telephone

5.16 (Symbol)(Arrow)
TDD
Telephone

5.17 (Symbol)(Optional Arrow)
Tickets

5.18 (Symbol)(Symbol)(Optional Arrow)
Elevator

5.19 (Symbol)(Optional Arrow)
Entrance

5.20 (Symbol)(Arrow)
Exit

5.21 (Symbol)(Optional Arrow)
Exit To
Street

5.22 (Symbol)(Arrow)
Ramp

5.23 (Symbol)(Arrow)
To Metra
Station

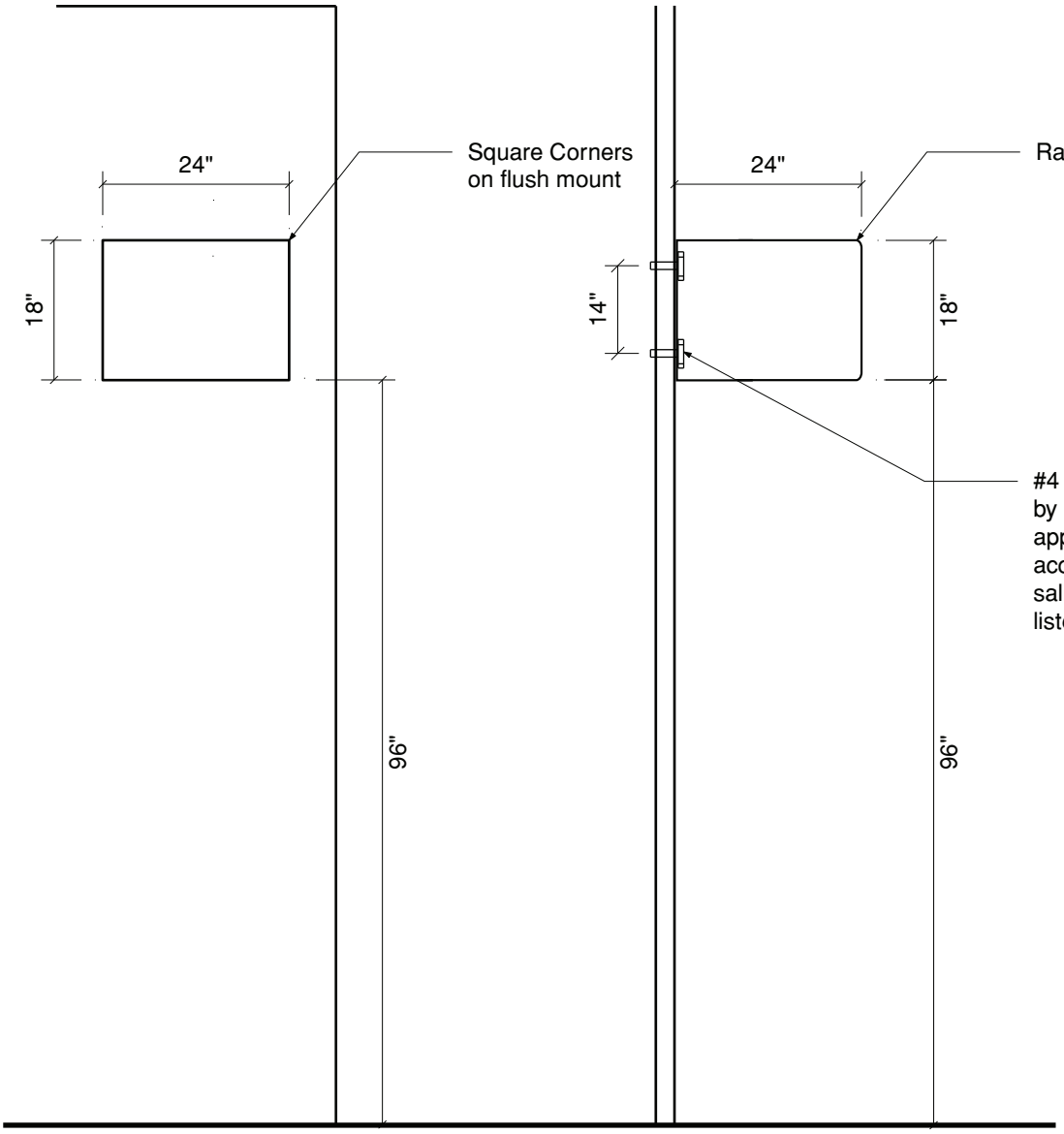
5.24 (Symbol)(Arrow)
To Metra
Station

5.25 Restricted
Access
Do Not Enter

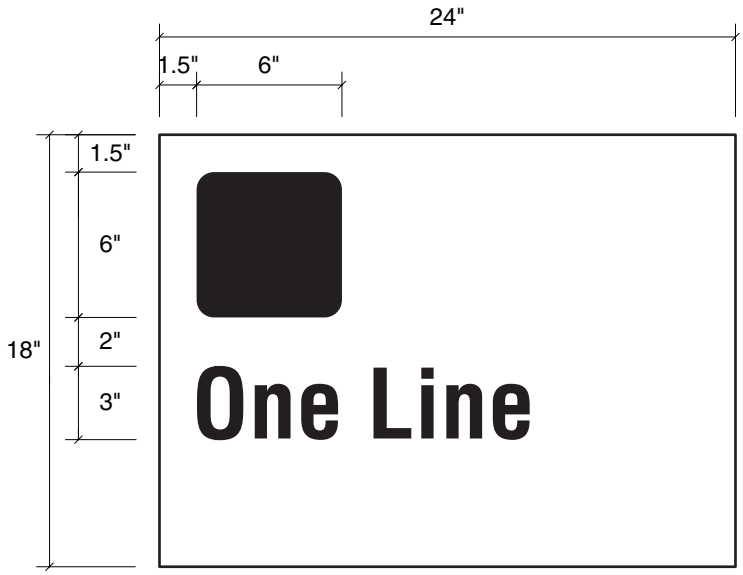
5.26 (Metra Logo)
Temporary
Ticket
Office

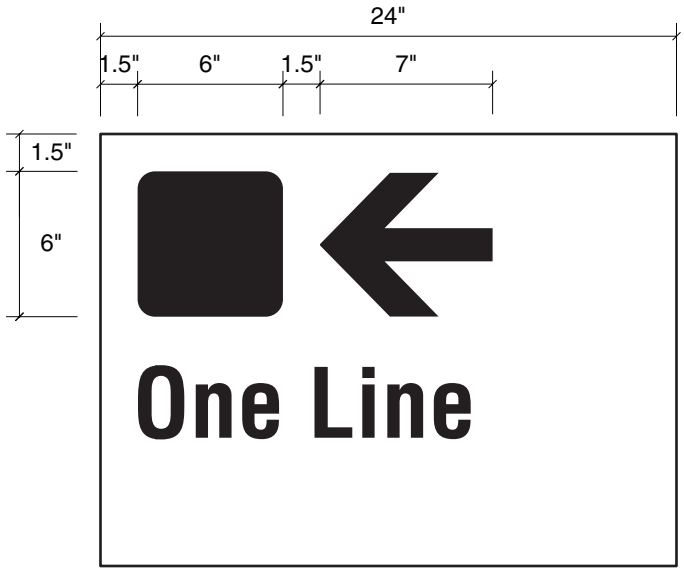
5.0 (Custom)

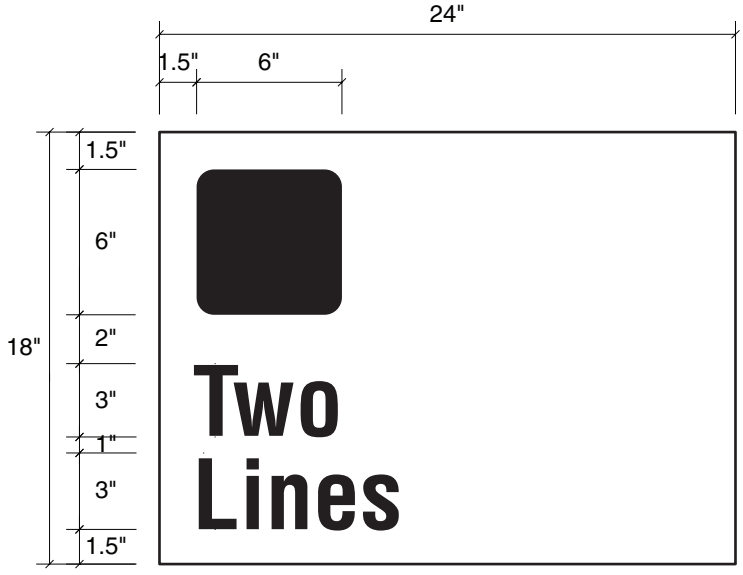
SIGN TYPE 5	Secondary Identification / Directional Specifications
Mounting Height:	96” from grade to bottom of sign
Panel Size:	18”H x 24”W
Material:	.125” aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed upper lower case
Copy Size:	3” cap height
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol:	Varies (see graphic details)
Symbol and Arrow Size:	6”
Symbol and Arrow Color:	White



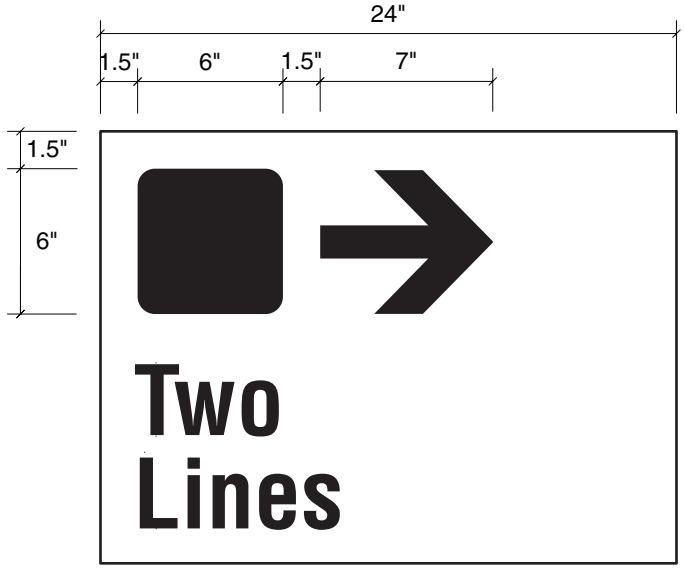
Flush Mount **Projecting Mount**





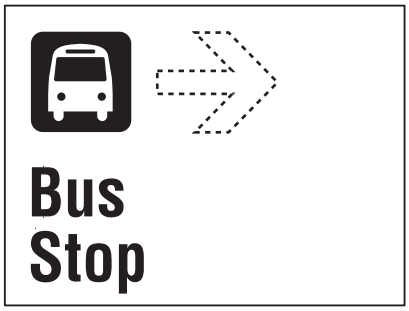


Identificational



Directional

Scale: 1 1/2” = 1’-0”



Sign Type 5.1
Used to identify direct commuters to buses (add arrow for directional sign)

Sign Type 5.2
Used to identify direct commuters to taxis (add arrow for directional sign)

Sign Type 5.3
Used to direct passengers to trains

Sign Type 5.4
Used to identify the platform from which to board trains that are headed to Chicago

Sign Type 5.5
Used to identify the platform from which to board trains headed away from Chicago

Sign Type 5.6
Used to direct passenger to the platform from which to board trains heading toward Chicago generally mounted in locations where stations and platforms are not visible

Sign Type 5.7
Used in locations where the station and platforms are not readily seen

Sign Type 5.8
Used to direct commuters to accessible routes to trains

Sign Type 5.9
Used to direct commuters to ramp to trains

Sign Type 5.13
Used to direct commuters to telephones

Sign Type 5.10
Used to direct commuters to ramp to trains headed to Chicago

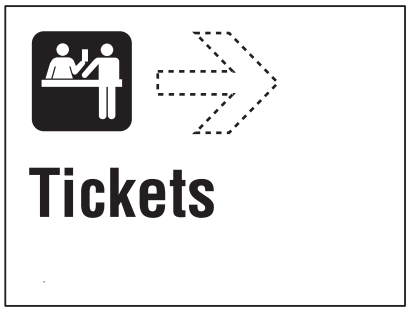
Sign Type 5.14
Used to direct commuters to accessible phones when not readily seen from platform

Sign Type 5.11
Used to direct commuters to ramp to trains coming from Chicago

Sign Type 5.15
Used to direct commuters to volume control phones when not readily seen from platform

Sign Type 5.12
Used to direct commuters to restrooms when they are not readily seen from main station area, can be used with or without symbol of accessibility as appropriate

Sign Type 5.16
Used to direct commuters to TDD phones when not readily seen from platform



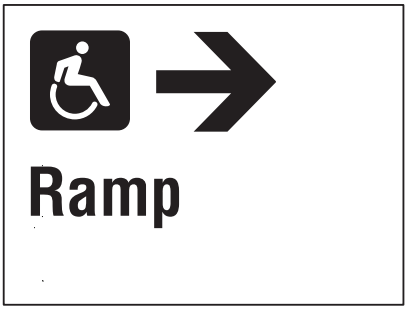
Sign Type 5.17
Used to identify ticket booth (add arrow for directional sign)

Sign Type 5.18
Used to identify and direct disabled commuters to elevators (add arrow for directional sign)

Sign Type 5.19
Used to identify and direct disabled commuters to accessible entrances (add arrow for directional sign)

Sign Type 5.20
Used to identify and direct disabled commuters to accessible exits (add arrow for directional sign)

Sign Type 5.21
Used to identify and direct disabled commuters to accessible exits to streets (add arrow for directional sign)

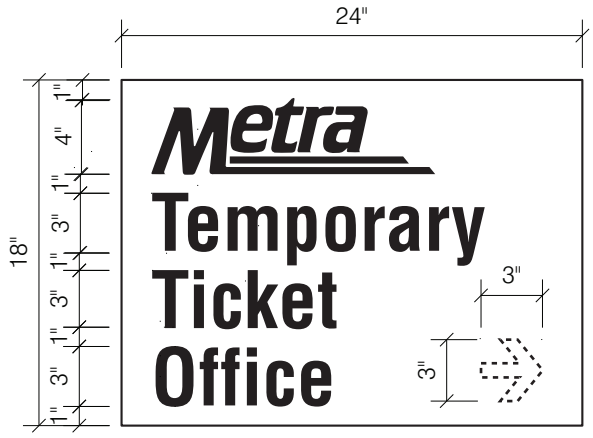


Sign Type 5.22
Used to direct disabled commuters to ramps

Sign Type 5.23
Used to direct disabled commuters to accessible paths to Metra Station

Sign Type 5.24
Used to direct passengers to the station, generally mounted at locations where the station is not readily seen

Sign Type 5.25
Restricted
Access
Do Not Enter



Sign Type 5.26
Temporary
Ticket
Office

Sign Type 5.0
Used for custom
messages.

Description:

The purpose of these signs is to identify public entrances to restrooms and other facilities and to restrict entry to areas not open to the public. The signs also identify smoking and nonsmoking areas. Copy is provided in tactile letters and braille.

Mounting:

All door signs are to be mounted flush to wall on latch side of door with foam tape and adhesive (see specifications below). These signs shall come furnished with double-faced foam tape along entire perimeter of back face.

Following are specifications, standard sign messages and schematics for Type 6 signs. Custom messages can be accommodated.

Adhesive shall be Silastic 732 M/Purpose adhesive by Dow Corning, or approved equal in accordance with the following salient characteristics:

- General-purpose: adhesion to Glass, Metal or Plastic
- One part, general purpose RTV adhesive/sealant
- Excellent temperature range: -60 to +230 C
- Non-slump
- Complies with FDA 21 CFR 177.2600, NSF, UL Listed and MIL-A-46106

Double-face, foam tape shall be VHB Tape by 3M, or approved equal in accordance with the following salient characteristics:

- General-purpose: adhesion to Glass, Metal or Plastic
- Construction grade
- High temperature range and outdoor rated
- Permanent bonding
- Meets ASTM D150, D140 and D257.

Sign Type 6:

6.1 (Symbol)(Symbol)
WOMEN
(Braille)

6.2 (Symbol)(Symbol)
MEN
(Braille)

6.3 (Symbol)(Symbol)
RESTROOM
(Braille)

6.4 (Symbol)
EMPLOYEES
ONLY
(Braille)

6.5 (Symbol)
NO
SMOKING
(Braille)

6.6 (Symbol)
SMOKING
PERMITTED
(Braille)

6.7 (Symbol)
LOST AND
FOUND
(Braille)

6.8 (Symbol)
METRA
POLICE
(Braille)

6.9 (Symbol)
EXIT
(Braille)

6.10 (Symbol)
NO
LOITERING
(Braille)

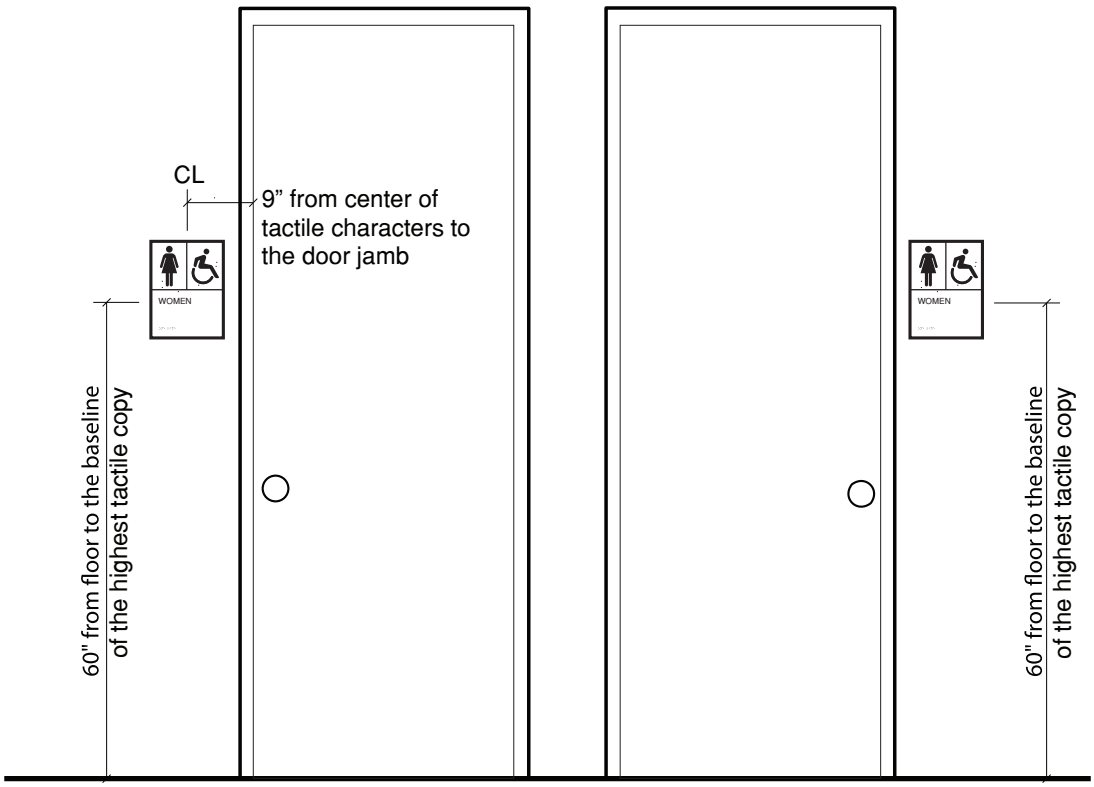
6.11 Track
5

6.0 Custom

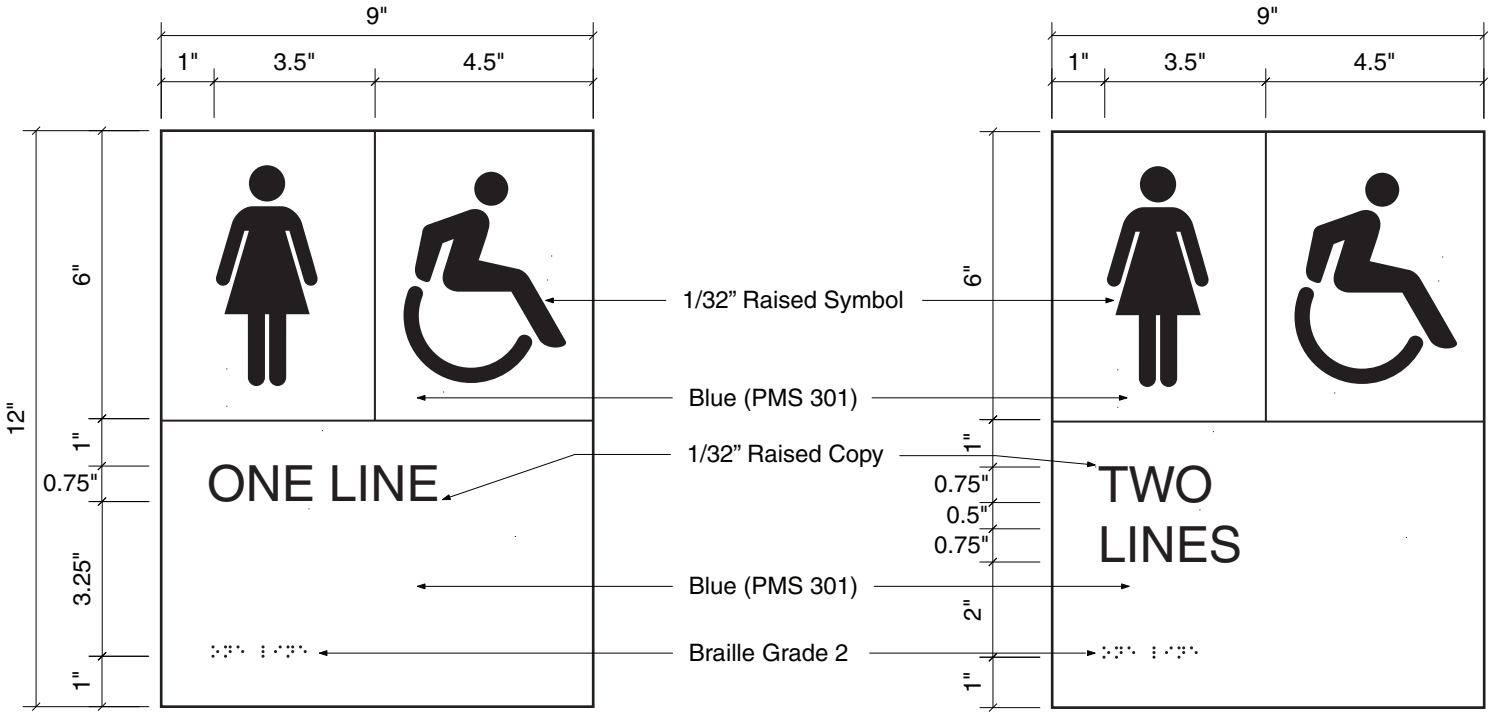
6.12 (Symbol)
Vending
(Braille)

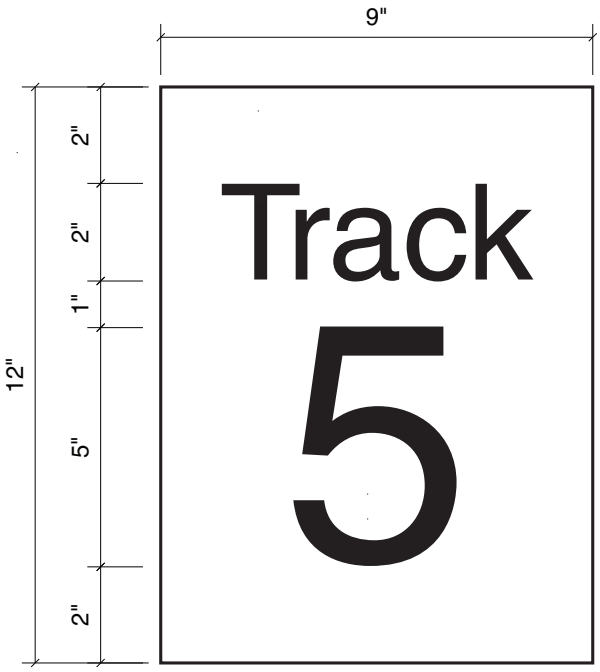
6.13 CALL FOR
AID OR
ELEVATOR
ASSISTANCE
(Braille)

SIGN TYPE 6	Door Identifier and Special Instruction Signs Interior Only – Flush Mount, One Sided
Mounting Height:	60” from floor to the baseline of the highest tactile copy
Panel Size:	12”H x 9”W
Material:	Photopolymer Sign material must be scratch and vandal-resistant, letters and symbol raised 1/32”
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Tactile: Letters raised 1/32” (photopolymer process NOT applied)
Letterform:	Helvetica Medium Upper Case, Raised 1/32”
Copy Size:	.75” cap height
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White, eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Braille:	Grade 2, raised 1/32” (photopolymer process NOT applied)
Symbol:	Varies (see graphic details), raised 1/32” (photopolymer process NOT applied)
Symbol Size:	3”
Symbol Color:	White



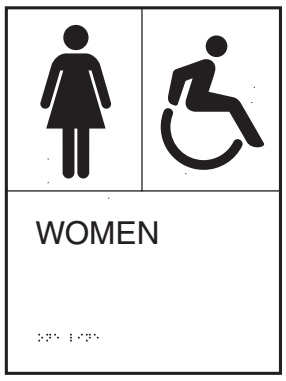
Flush mounted to LATCH SIDE of door





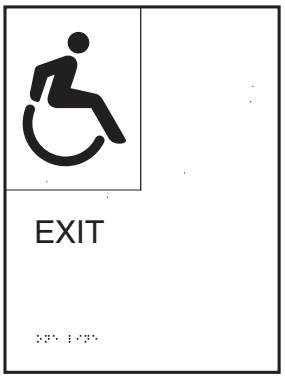
This version used at downtown terminals as track identifier

Note: All grade 2 braille characters, that are shown in this page, are only representational.

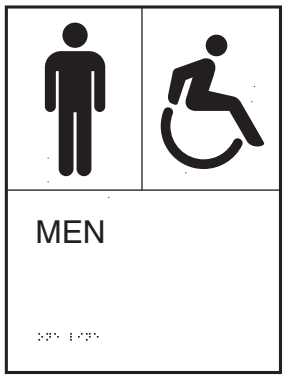


Sign Type 6.1
Can be used with or without Symbol of Accessibility as appropriate

Sign Type 6.5



Sign Type 6.9



Sign Type 6.2
Can be used with or without Symbol of Accessibility as appropriate

Sign Type 6.6

Sign Type 6.10

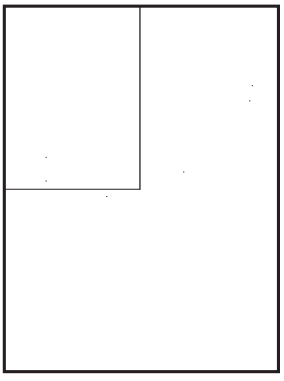
Sign Type 6.3
Can be used with or without Symbol of Accessibility as appropriate

Sign Type 6.7

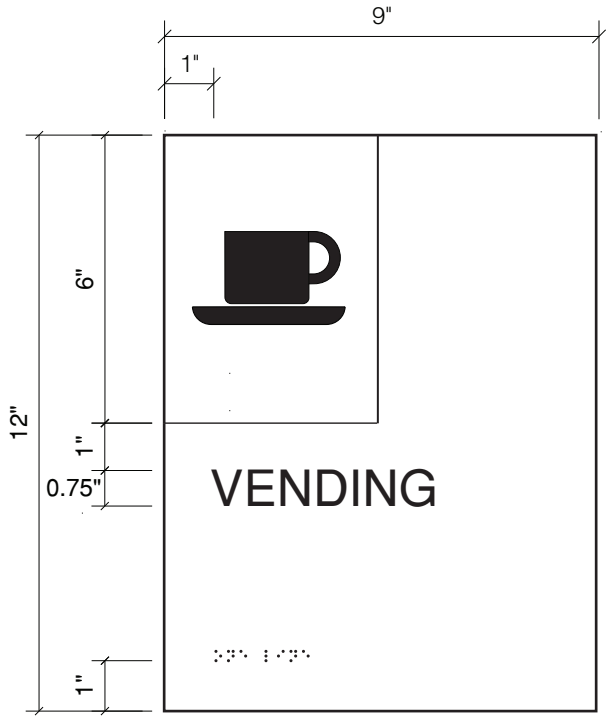
Sign Type 6.11
Can be used with or without Symbol of Accessibility as appropriate

Sign Type 6.4

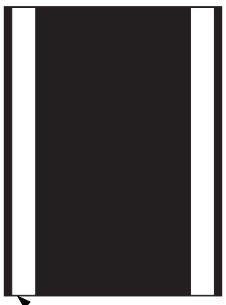
Sign Type 6.8



Sign Type 6.0
Custom



Sign Type 6.12
Vending



Back Side

1" Wide V.H.B. Double Stick Tape, or approved equal in accordance with the salient characteristics listed on page 97.

Sign Type 6.13
Call For
Aid or
Elevator
Assistance

1/8" THK. Raised Border byMetal Etched Process. Color White.

Letters raised 1/32" by Metal Raised Process. Color White.

Panel color to match PMS 301

1/4" Dia. Pre-drilled holes to receive countersunk temperproof screws.

Description:

The purpose of these signs is to regulate parking as well as to identify and direct commuters to accessible entrances, exits, ramps, etc. at smaller stations.

Mounting:

All signs are capable of being mounted by two methods- post and projecting mountings. An aluminum extrusion of the sign panel slides into a channel on the standard 2” x 2” aluminum post for post mounted signs. Projecting signs may be mounted to an existing post on the site, such as a light post, telephone pole etc.

Following are specifications, standard sign messages and schematics for Type 7 signs. Custom messages can also be accommodated.

Sign Type 7:

7.1 (Symbol) Bus Stop

7.2 (Symbol) Taxi

7.3 (Symbol) Kiss 'N Ride

7.3A (Symbol)(Symbol) Kiss 'N Ride

7.3B (Symbol)(Symbol) Kiss 'N Ride 15 Min. Parking

7.4 (Symbol) Commuter Parking

7.5 (Symbol) No Parking

7.6 (Symbol) Railroad Employee Parking Only

7.7 (Symbol) Entrance (Arrow)

7.8 (Symbol) Accessible Exit (Arrow)

7.9 (Symbol) Exit To Streets (Arrow)

7.10 (Symbol) Ramp (Arrow)

7.11 (Symbol) To trains (Arrow)

7.12 (Symbol) Ramp To Trains (Arrow)

7.13 (Symbol) Ramp To Chicago (Arrow)

7.14 (Symbol) Ramp From Chicago (Arrow)

7.15 (Symbol) To Metra Station (Arrow)

7.16 (Symbol) To Main Station (Arrow)

7.17 (Symbol) Board Here

7.18 (Symbol) Accessible Boarding Area (Arrow)

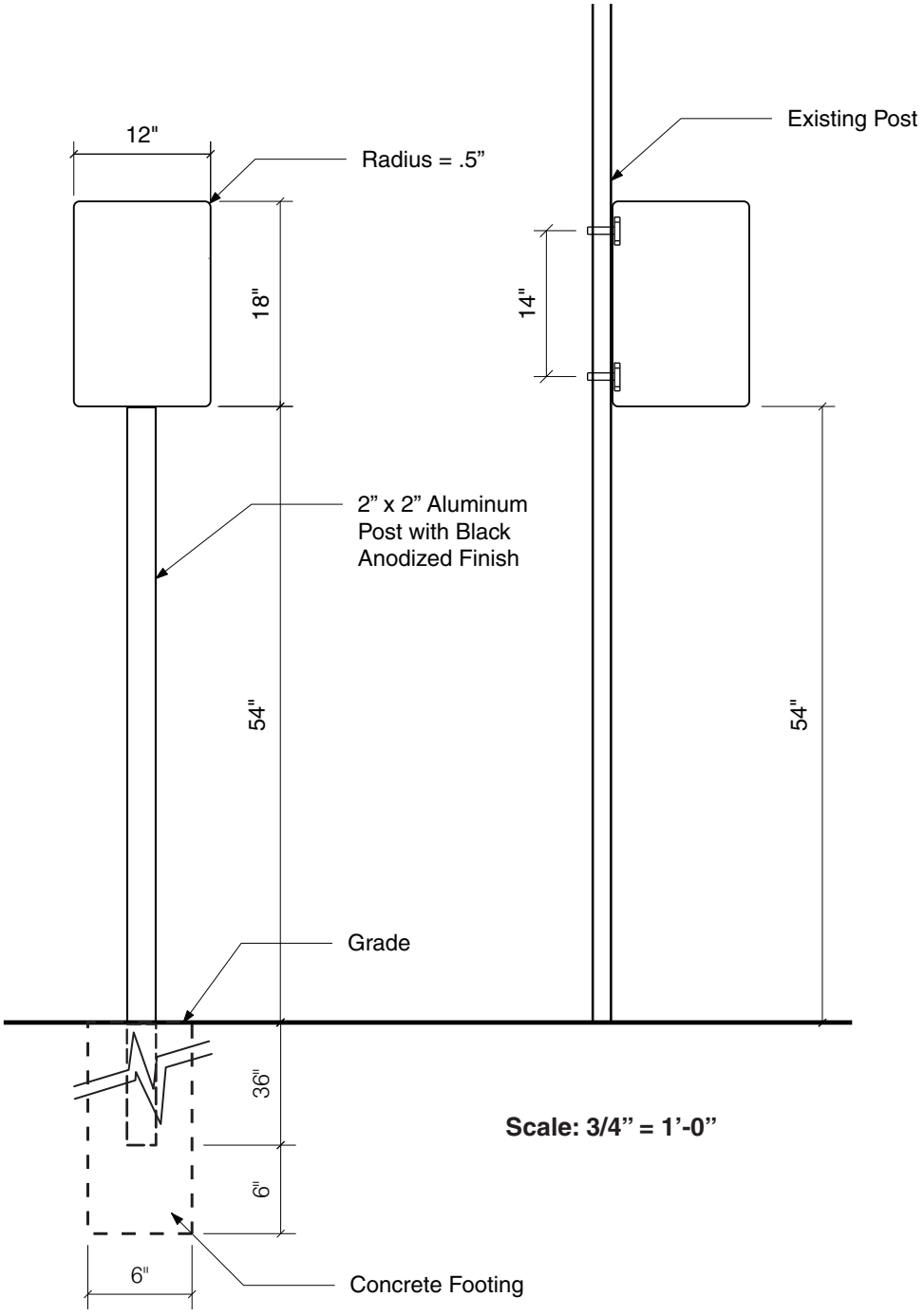
Sign Type 7:

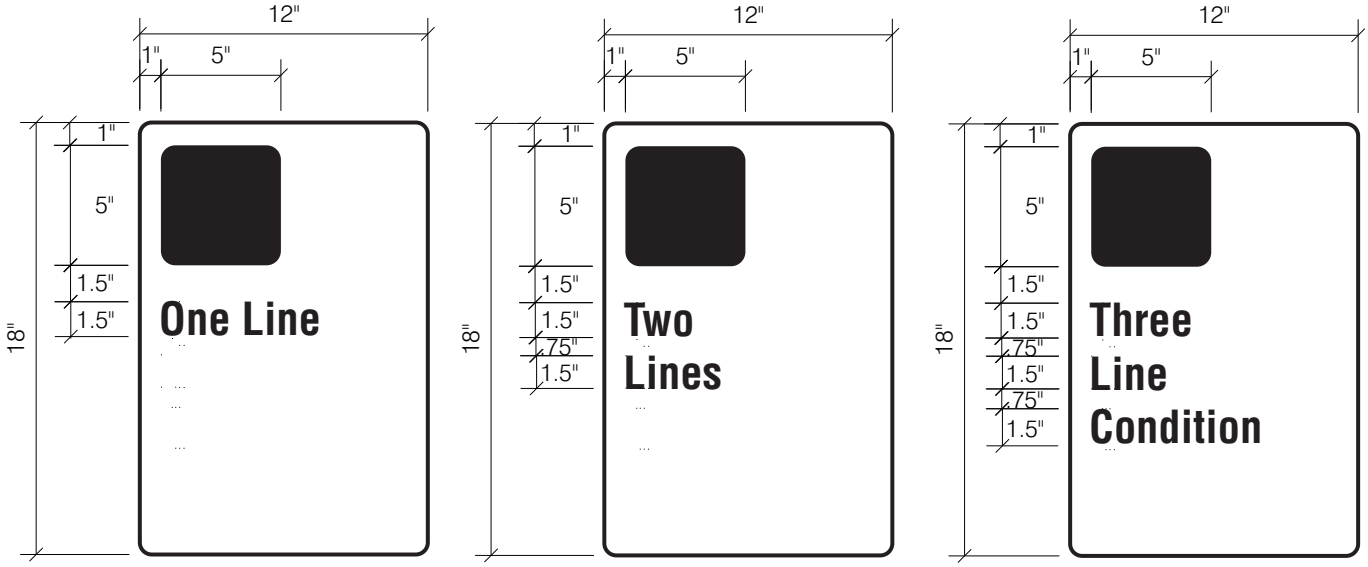
7.19 RESERVED
Parking
(Symbol)
(Double arrow)

$300 Fine
(appears on a separate panel)

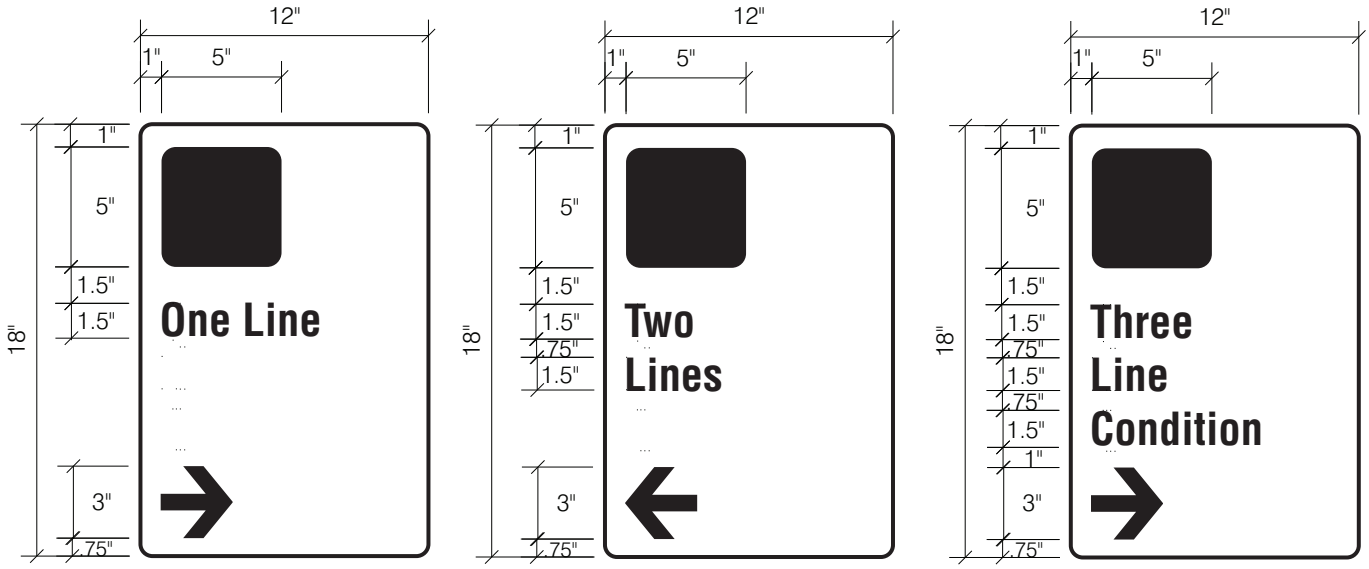
7.0 Custom

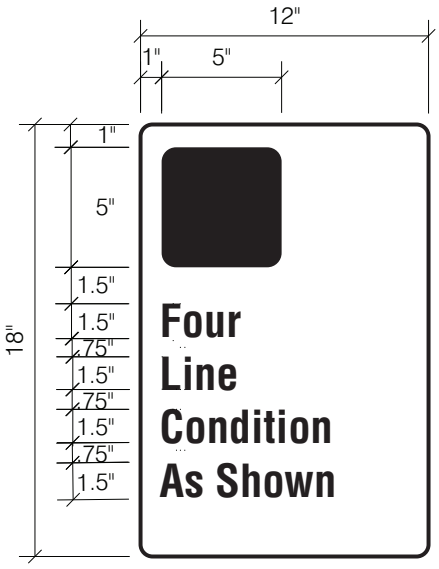
SIGN TYPE 7	Tertiary Identification / Directional Specifications
Post Height:	54” from grade to bottom of sign
Panel Size:	18”H x 12”W
Material:	.125” aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed
Copy Size:	1.5”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol:	Varies (see graphic details)
Symbol Size:	5”
Symbol Color:	White
Arrow Size:	3”
Arrow Color:	White


12"
Radius = .5”
18"
14"
Existing Post
2” x 2” Aluminum Post with Black Anodized Finish
54"
54"
Grade
36"
6"
6"
Concrete Footing
Scale: 3/4” = 1’-0”



Identification





Identification

Sign Type 7.1

Used to identify and direct commuters to bus stop.

Sign Type 7.3A

Used to identify and direct commuters to drop-off and pick-up areas.

Sign Type 7.5

Sign Type 7.2

Used to identify and direct commuters to taxis.

Sign Type 7.3B

Sign Type 7.6

Sign Type 7.3

Used to identify and direct commuters to drop-off and pick-up areas.

Sign Type 7.4

Sign Type 7.7

Used to direct commuters to accessible entrances.

Sign Type 7.8

Used to direct disabled commuters to accessible exit.

Sign Type 7.11

Used to direct disabled commuters to trains.

Sign Type 7.14

Used to direct disabled commuters to ramp to trains coming from Chicago.

Sign Type 7.9

Used to direct disabled commuters to accessible exits to streets.

Sign Type 7.12

Used to direct disabled commuters to ramp to trains.

Sign Type 7.15

Used to direct disabled commuters to accessible paths to station.

Sign Type 7.10

Used to direct disabled commuters to ramps.

Sign Type 7.13

Used to direct disabled commuters from ramp to trains heading to Chicago.

Sign Type 7.16

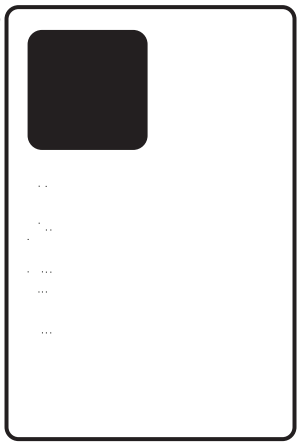
Used to direct disabled commuters to accessible paths to main station area at large stations.

Sign Type 7.17

Used to identify boarding area for accessible train cars.

Sign Type 7.18

Used to direct disabled commuters to boarding area for train cars.



Sign Type 7.0

Used for custom messages.

Sign Type 7.19

Reserved Parking

Used to reserve parking spaces for disabled commuters.

Colors:
Legend and Border - Green
White Symbol on Blue Background
Background - White

These signs must follow the Illinois Accessibility Code current specifications refered to as R7-8 and R7-I101 (See page 217 - 218 for details).

Arrow is optional, but not typical on Metra's parking signs

Fine amount based on current regulatory requirementsns

Description:

This sign type is specified when installing sign type 6.5 is not desirable, such as on a glass shelter, or in a high-vandalism area. All Decals (sign types 8A to 8E) are die cut decals, appropriate for glass or out of reach surfaces. These decals are repositionable, removable and resusable. Sign type 8A to 8E decals can be specified for first surface or second surface applications and can be single or double sided. They shall be removable for up to two years in indoor or indoor/outdoor locations.

Sign type 8F decals are vinyl patches that are intended to cover portions of or faces of existing exterior signs or equipment for a minimum of three years. They are specified for first surface applications and are single sided.

Following are specifications and schematics for Type 8 signs.

Sign Type 8:

8A Decal (5” x 5” or smaller)

8B Decal (7” x 7” or 7” x 5”)

8C Decal (11” x 17”)

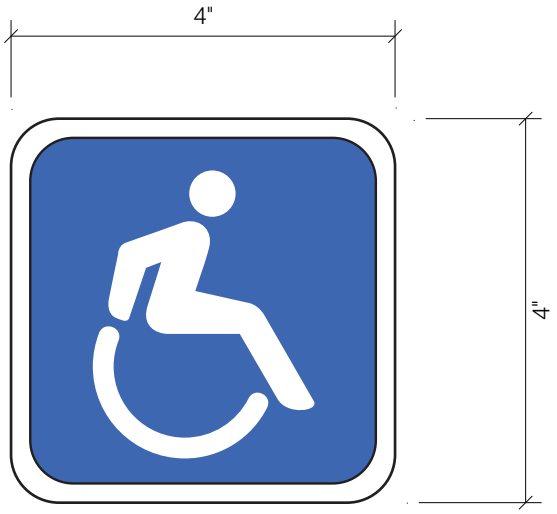
8D Decal (21” x 20”)

8E Decal (by the square foot, up to 36” wide)

8F Vinyl Patch (by the square foot)

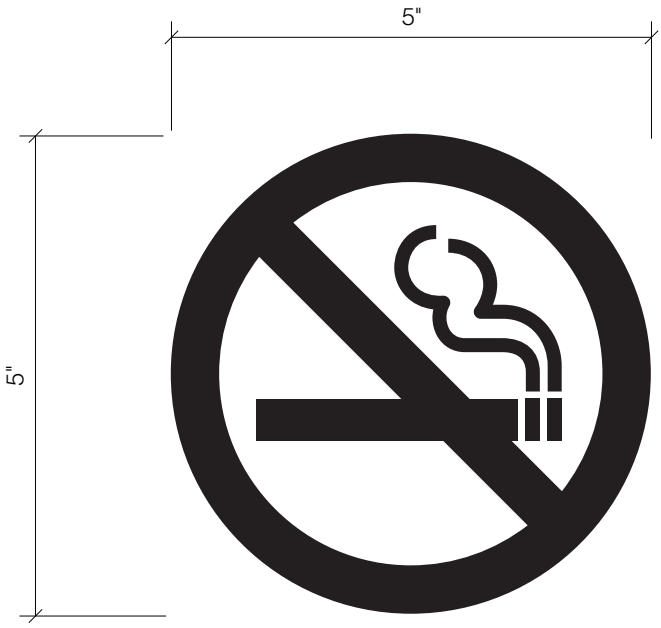
SIGN TYPE 8A	Vinyl Decal - 5” x 5” or Smaller Specifications
Mounting Height:	66” bottom of symbol to grade (Actual conditions may vary and may require a custom specification.)
Size:	5” x 5” or smaller
Material:	Repositionable, removable, reusable die-cut vinyl. Shall be fabricated from a pressure sensitive, adhesive-backed, high tensile strength vinyl film. Pressure sensitive decals shall not be merely a film constructed of inks and lacquers with an adhesive backing. Class D - Promotional 6 Month to One Year - Class D Decals shall be removable for up to two years, with little or no adhesive residue, from most surfaces, without the aid of accessories or chemical strippers. Can be specified for first or second surface applications. Can be double or single sided. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.
Weather Resistance:	Decals shall be water resistant. The weathering quality of the decals shall be such that they show no apprecialbe deterioration such as cracking, checking, blistering, delamination (peeling), or loss of adhesion after one (1) year of field use. A slight amount of color fading and chalking is permissible.
Symbol Color:	Clear, Red, Blue, White and Black

NOTE: Artwork, colors and messaging may vary.

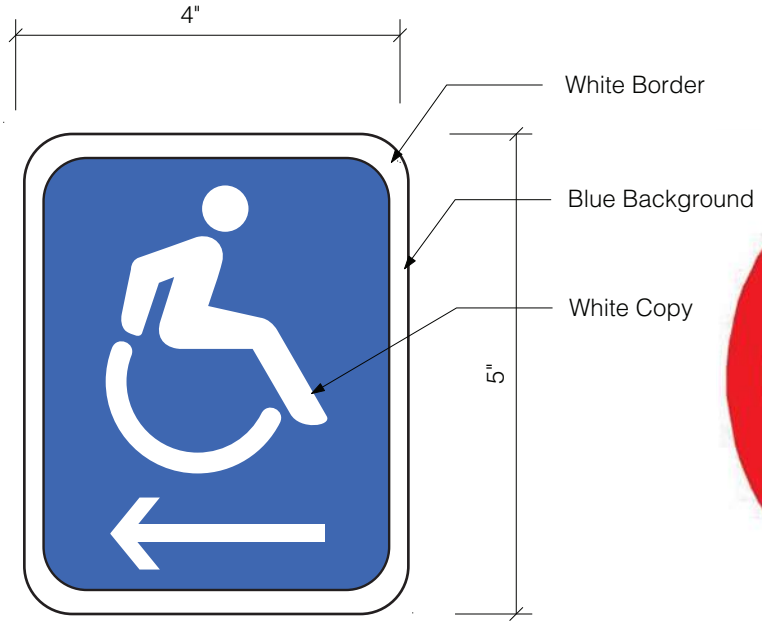


DOUBLE SIDED

SECOND SURFACE APPLY (Adhesive on Front)



Actual symbol color is white



DOUBLE SIDED

SECOND SURFACE APPLY
(Adhesive on Front)

Actual symbol color is
red and black

SIGN TYPE 8B	Vinyl Decal - 7” x 7” or 7” x 5” Specifications
Mounting Height:	60” bottom of symbol to grade (Actual conditions may vary and may require a custom specification.)
Size:	7” x 7” or 7” x 5”
Material:	Repositionable, removable, reusable die-cut vinyl. Shall be fabricated from a pressure sensitive, adhesive-backed, high tensile strength vinyl film. Pressure sensitive decals shall not be merely a film constructed of inks and lacquers with an adhesive backing. Class D - Promotional 6 Month to One Year - Class D Decals shall be removable for up to two years, with little or no adhesive residue, from most surfaces, without the aid of accessories or chemical strippers. Can be specified for first or second surface applications. Can be double or single sided. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.
Weather Resistance:	Decals shall be water resistant. The weathering quality of the decals shall be such that they show no apprecialbe deterioration such as cracking, checking, blistering, delamination (peeling), or loss of adhesion after one (1) year of field use. A slight amount of color fading and chalking is permissible.
Symbol Color:	Black, Red, Grey, White

NOTE: Artwork, colors and messaging may vary.


5"
7"
5.5"
1.5"
NO SMOKING
Indoors or Within 15 FT of Entrance
Pursuant to the Smoke-Free Illinois Act 95-0017
To file a complaint:
www.smoke-free.illinois.gov
866-973-4646
TTY 800-547-0466 (hearing impaired use only)
Red Copy
Black Copy
Grey Background
White Background
Black Symbol
Red Symbol
Black Symbol
Black Copy
Red Copy
Black Copy
White Background

Mounting Height:	Varies
Size:	11” x 17”
Material:	Repositionable, removable, reusable die-cut vinyl. Shall be fabricated from a pressure sensitive, adhesive-backed, high tensile strength vinyl film. Pressure sensitive decals shall not be merely a film constructed of inks and lacquers with an adhesive backing. Class D - Promotional 6 Month to One Year - Class D Decals shall be removable for up to two years, with little or no adhesive residue, from most surfaces, without the aid of accessories or chemical strippers. Can be specified for first or second surface applications. Can be double or single sided. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.
Weather Resistance:	Decals shall be water resistant. The weathering quality of the decals shall be such that they show no apprecialbe deterioration such as cracking, checking, blistering, delamination (peeling), or loss of adhesion after one (1) year of field use. A slight amount of color fading and chalking is permissible.
Copy Color:	White
Background Color:	Blue (PMS 301)

NOTE: Artwork, colors and messaging may vary.

BOARDING INFORMATION

THE FOLLOWING WEEKDAY TRAINS NOW BOARD FROM **PLATFORM #3**, OPPOSITE THE STATION SIDE:

7:35 AM (Train No. 28 to Chicago)
8:01 AM (Train No. 34 to Chicago)
11:06 AM (Train No. 44 to Chicago)
1:06 PM (Train No. 48 to Chicago)
2:06 PM (Train No. 50 to Chicago)
3:06 PM (Train No. 52 to Chicago)
4:06 PM (Train No. 54 to Chicago)
6:28 PM (Train No. 60 to Chicago)
8:06 PM (Train No. 64 to Chicago)
9:06 PM (Train No. 66 to Chicago)
10:06 PM (Train No. 68 to Chicago)
11:06 PM (Train No. 70 to Chicago)

Metra

SIGN TYPE 8D	Vinyl Decal - 20” x 21” Specifications
Mounting Height:	48” bottom of sign to grade (Actual conditions may vary and may require a custom specification.)
Size:	20” x 21”
Material:	Repositionable, removable, reusable die-cut vinyl. Shall be fabricated from a pressure sensitive, adhesive-backed, high tensile strength vinyl film. Pressure sensitive decals shall not be merely a film constructed of inks and lacquers with an adhesive backing. Class D - Promotional 6 Month to One Year - Class D Decals shall be removable for up to two years, with little or no adhesive residue, from most surfaces, without the aid of accessories or chemical strippers. Can be specified for first or second surface applications. Can be double or single sided. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.
Weather Resistance:	Decals shall be water resistant. The weathering quality of the decals shall be such that they show no apprecialbe deterioration such as cracking, checking, blistering, delamination (peeling), or loss of adhesion after one (1) year of field use. A slight amount of color fading and chalking is permissible.
Copy and Border Color:	Varies
Symbol Color:	Varies
Background Color:	Varies

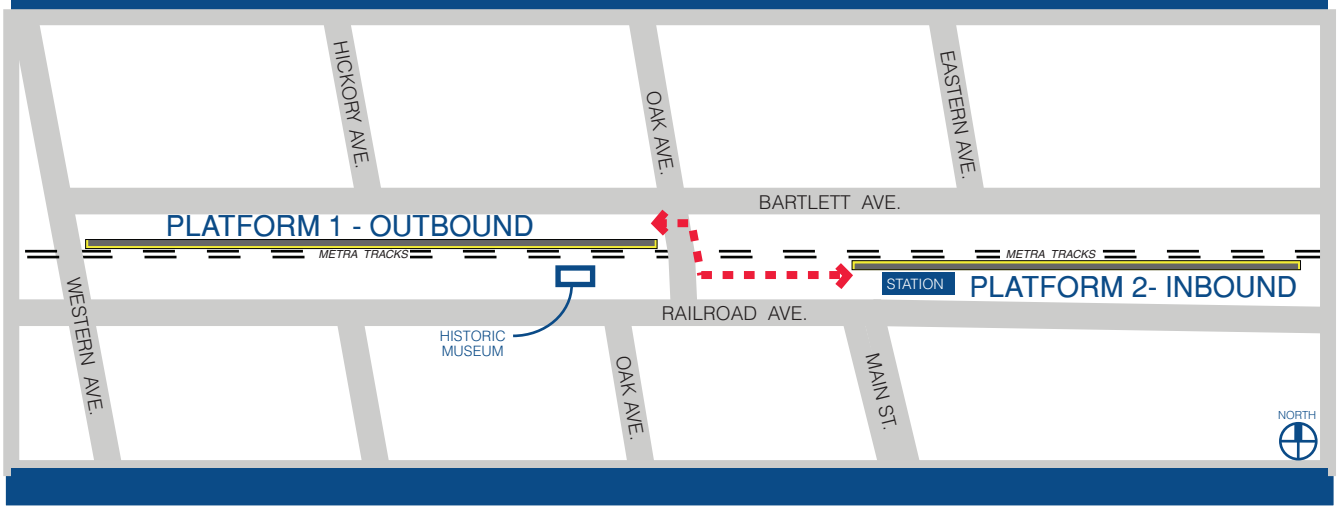
NOTE: Artwork, colors and messaging will vary.

TRAINS TO CHICAGO
NORMALLY BOARD FROM PLATFORM 2 (STATION SIDE)

TRAINS FROM CHICAGO
NORMALLY BOARD FROM PLATFORM 1
(ACROSS THE OAK STREET PEDESTRIAN CROSSING)

TRAINS MAY OPERATE ON OPPOSITE PLATFORMS.

PLEASE LISTEN FOR PLATFORM CHANGE ANNOUNCEMENTS.



NOTE: Artwork supplied by Metra

Mounting Height:	Varies
Size:	Varies, to be measured by the Square Foot, Up to 36” Wide.
Material:	Repositionable, removable, reusable die-cut vinyl. Shall be fabricated from a pressure sensitive, adhesive-backed, high tensile strength vinyl film. Pressure sensitive decals shall not be merely a film constructed of inks and lacquers with an adhesive backing. Class D - Promotional 6 Month to One Year - Class D Decals shall be removable for up to two years, with little or no adhesive residue, from most surfaces, without the aid of accessories or chemical strippers. Can be specified for first or second surface applications. Can be double or single sided. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.
Weather Resistance:	Decals shall be water resistant. The weathering quality of the decals shall be such that they show no apprecialbe deterioration such as cracking, checking, blistering, delamination (peeling), or loss of adhesion after one (1) year of field use. A slight amount of color fading and chalking is permissible.

NOTE: Artwork, colors and messaging will vary.

NOTE:
Second surface graphics and
double sided decal.

SIGN TYPE 8F	Vinyl Patch Specifications
Mounting Height:	Varies
Size:	Varies, to be measured by Square Foot
Material:	Shall be fabricated from a pressure sentitive adhesive-backed, high tensile strength, opaque vinyl film. Intended for use on exterior surfaces of vehicles, equipment or existing signs. All decals shall be free from blisters, cracks, foreign matter and other imperfections.
Thickness:	Film shall be 0.003” to 0.005” (0.0762mm to 0.0127mm) thick. This thickness does not include the adhesive, liner (backing paper release), clear protective coating or overlaminate film, or transfer tape (when needed).
Liner (Backing Paper Release:	All pressure sensitive vinyl patches shall have at least one score in the backing paper for easy application of the decal. Liner (backing paper relelase) - One year after manufacture, decals furnished shall release from their liners with equal ease as the newly manufactured products.

Note: Messaging, colors and artwork may vary.

2” Copy Height
White Copy
Metra blue background

2” Copy Height
White Copy
Metra blue background

NOTE: Artwork, colors and messaging will vary.

Description: The purpose of these signs is to provide direction to Metra Stations on municipal roads.

Mounting: These signs are capable of being mounted on a single post, or mounted onto another surface, such as a lightpost. All mountings shall utilize tamperproof hardware painted out to match face of sign.

Following are specifications and schematics for Type 9 signs.

Sign Type 9:

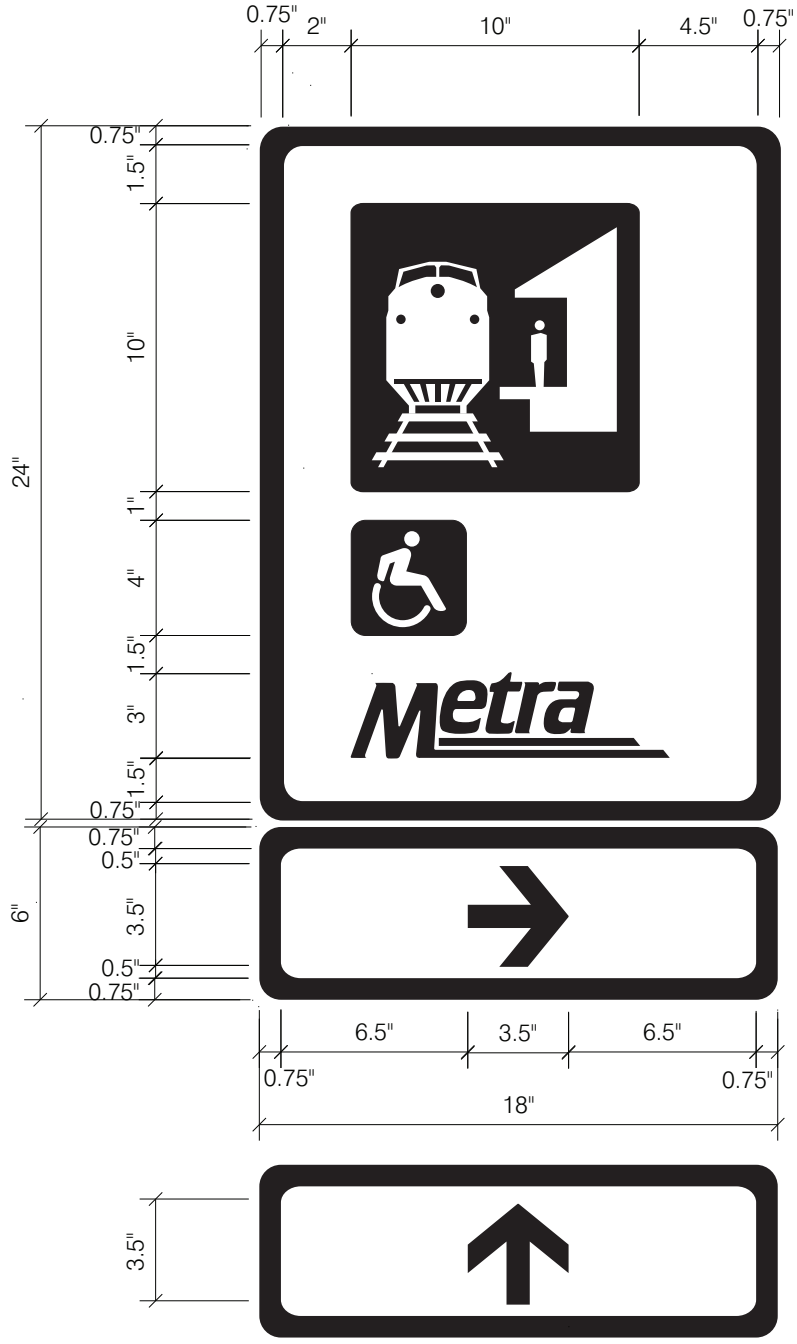
9A Trailblazer sign-with symbol of accessibility

9B Trailblazer sign

9C Trailblazer sign

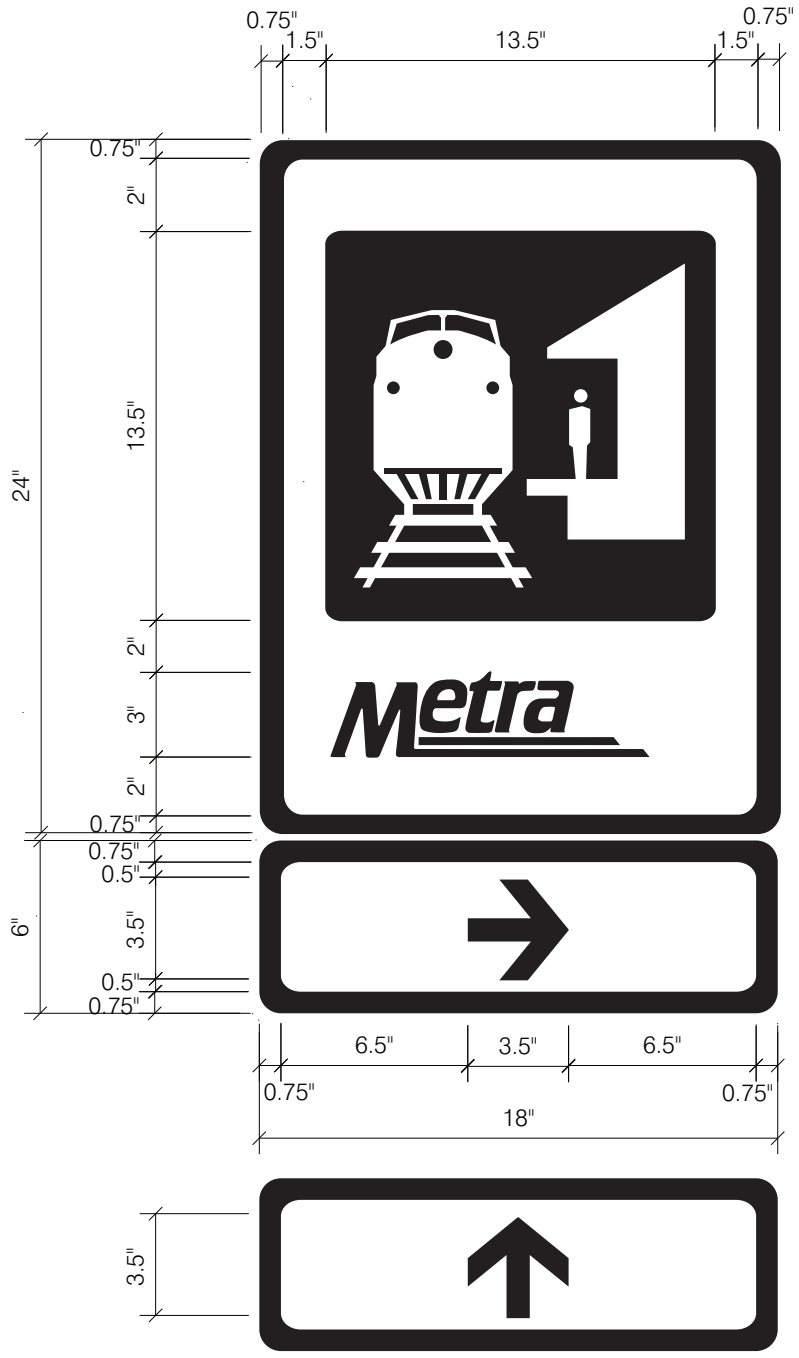
9D Major Station Identifier

SIGN TYPE 9A	Trailblazer Sign - with symbol of accessibility Specifications
Panel Size:	24”H X 18”W
Arrow Panel Size:	6”H X 18”W
Material:	.125” aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Symbols:	Train station symbol, boarder, symbol of accessibility and Metra logo exterior grade vinyl die-cut or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Symbol SIze:	Train station - 10” Symbol of accessibility - 4” Metra logo - 3”
Symbol & Boarder Color:	White
Arrow Size:	3.5”
Arrow Color:	White
Copy Color:	White



Note: Each sign unit shall include one arrow panel.

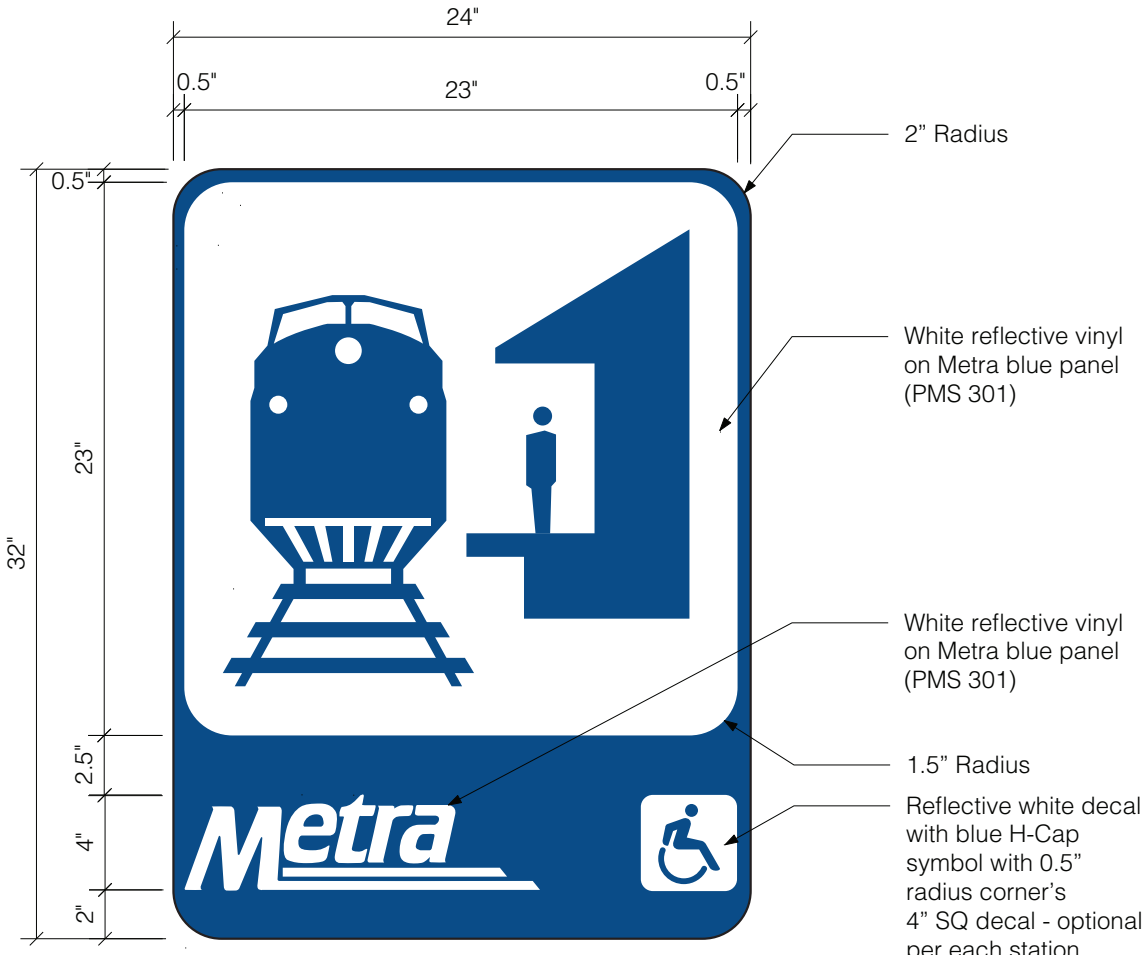
SIGN TYPE 9B	Trailblazer Sign Specifications
Panel Size:	24”H X 18”W
Arrow Panel Size:	6”H X 18”W
Material:	.125” aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Symbols:	Train station symbol, boarder, and Metra logo exterior grade vinyl die-cut or silk-screened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Symbol SIze:	Train station - 13.5” Metra logo - 3”
Symbol & Boarder Color:	White
Arrow Size:	3.5”
Arrow Color:	White
Copy Color:	White


0.75"
1.5"
13.5"
1.5"
0.75"
0.75"
2"
13.5"
24"
2"
3"
2"
0.75"
0.75"
0.5"
6"
3.5"
0.5"
0.75"
Metra
6.5"
3.5"
6.5"
0.75"
0.75"
18"
3.5"

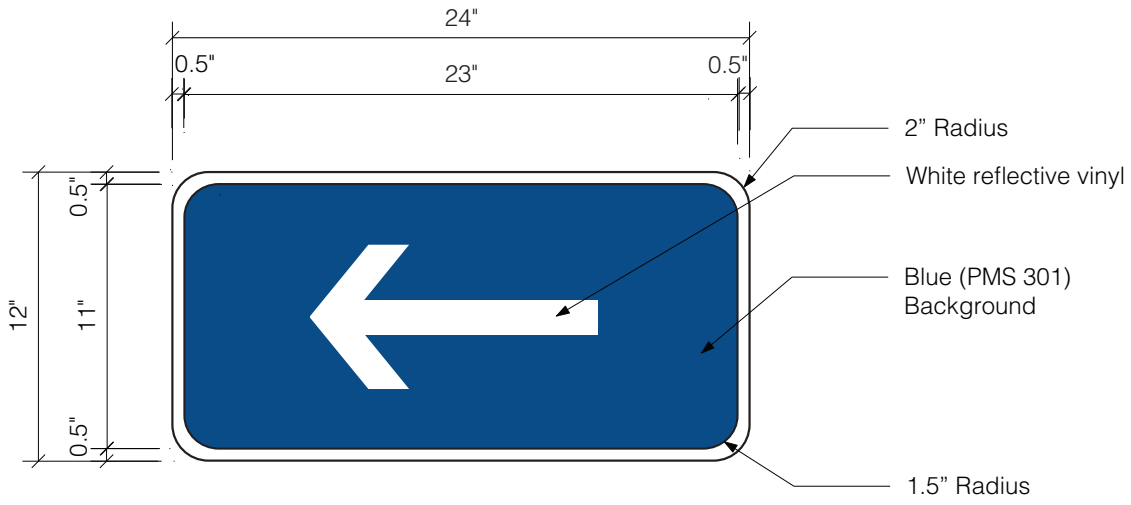
Sign Type:	9 C (Sign I)
Size:	32”h X 24”w
Panel Material:	.125” Aluminum
Panel Color:	Paint to Match PMS 301
Symbol Style:	Train, H-cap
Symbol Size:	Varies
Symbol Color:	White Construction Grade Reflective Vinyl
Logo Style:	Custom
Logo Size:	4”
Logo Color:	White Contruction Grade Reflective Vinyl
Accent Style:	Border
Accent Size:	1/2”
Accent Color:	Blue Bkgrd Panel
Mounting Method:	TBD
Installation Method:	TBD

Arrow Sign Specifications

Sign Type:	9 C (Sign 2)
Size:	12”H X 24”W
Panel Material:	.125” Aluminum
Panel Color:	Paint to Match PMS 301
Arrow Style:	Custom
Arrow Size:	5 3/4”
Arrow Color:	White Construction Grade Reflective Vinyl
Accent Style:	Border
Accent Size:	1/2”
Accent Color:	White Construction Grade Reflective Vinyl
Mounting Method:	TBD
Installation Method:	TBD

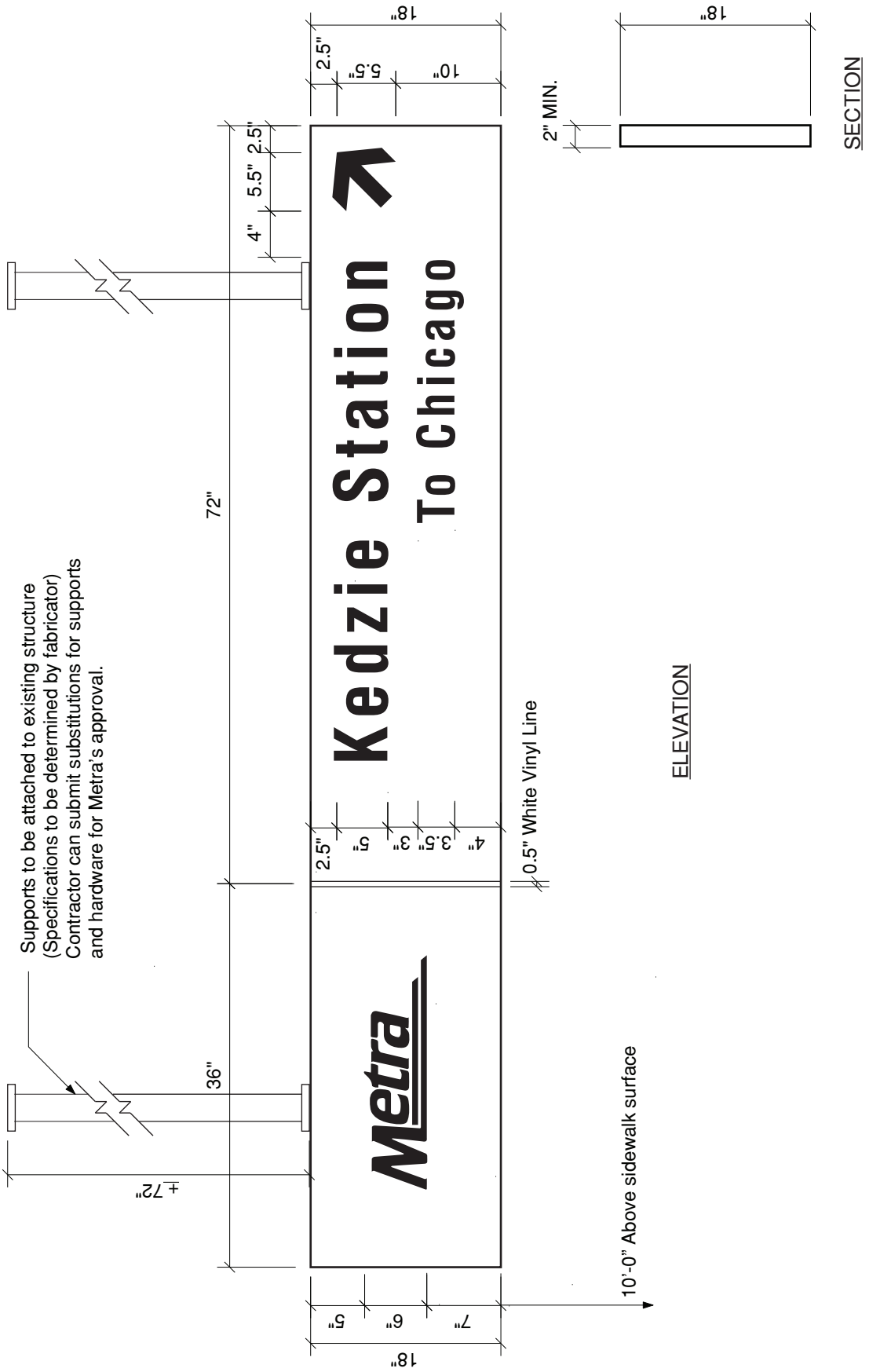

24"
0.5"
23"
0.5"
2" Radius
0.5"
23"
32"
White reflective vinyl
on Metra blue panel
(PMS 301)
White reflective vinyl
on Metra blue panel
(PMS 301)
2.5"
4"
2"
1.5" Radius
Reflective white decal
with blue H-Cap
symbol with 0.5"
radius corner's
4" SQ decal - optional
per each station.
Metra

(SIGN 1)


24"
0.5"
23"
0.5"
2" Radius
White reflective vinyl
0.5"
12"
11"
0.5"
Blue (PMS 301)
Background
1.5" Radius

(SIGN 2)

SIGN TYPE 9D	Major Station Identifier Specifications
Size:	18”H X 108W X 2” THK
Material:	.125” Aluminum plate
Finish:	Painted acrylic polyurethane w/UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed
Copy Size:	Two line condition- 5” Cap height on station name - 3 1/2” Cap height on secondary name
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Mounting:	Ceiling mounted (Specifications for supports and hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)


Kedzie Station
To Chicago
Metra
72"
36"
± 72"
18"
2.5"
5.5"
10"
2.5"
5.5"
4"
2.5"
5"
3"
3.5"
4"
0.5" White Vinyl Line
7"
6"
5"
18"
10'-0" Above sidewalk surface
Supports to be attached to existing structure
(Specifications to be determined by fabricator)
Contractor can submit substitutions for supports
and hardware for Metra's approval.
ELEVATION
18"
2" MIN.
SECTION

Description: The purpose of these signs is to caution commuters, pedestrians, and cyclists at station platform and railroad crossing.

Mounting: These signs are capable of being mounted on a single or double post, or mounted onto another surface, such as a lightpost or intertrack fencing. All mounting shall utilized tamperproof hardware painted out to match face of sign.

Followings are specifications and schematics for Type 10 signs.

Sign Type 10:

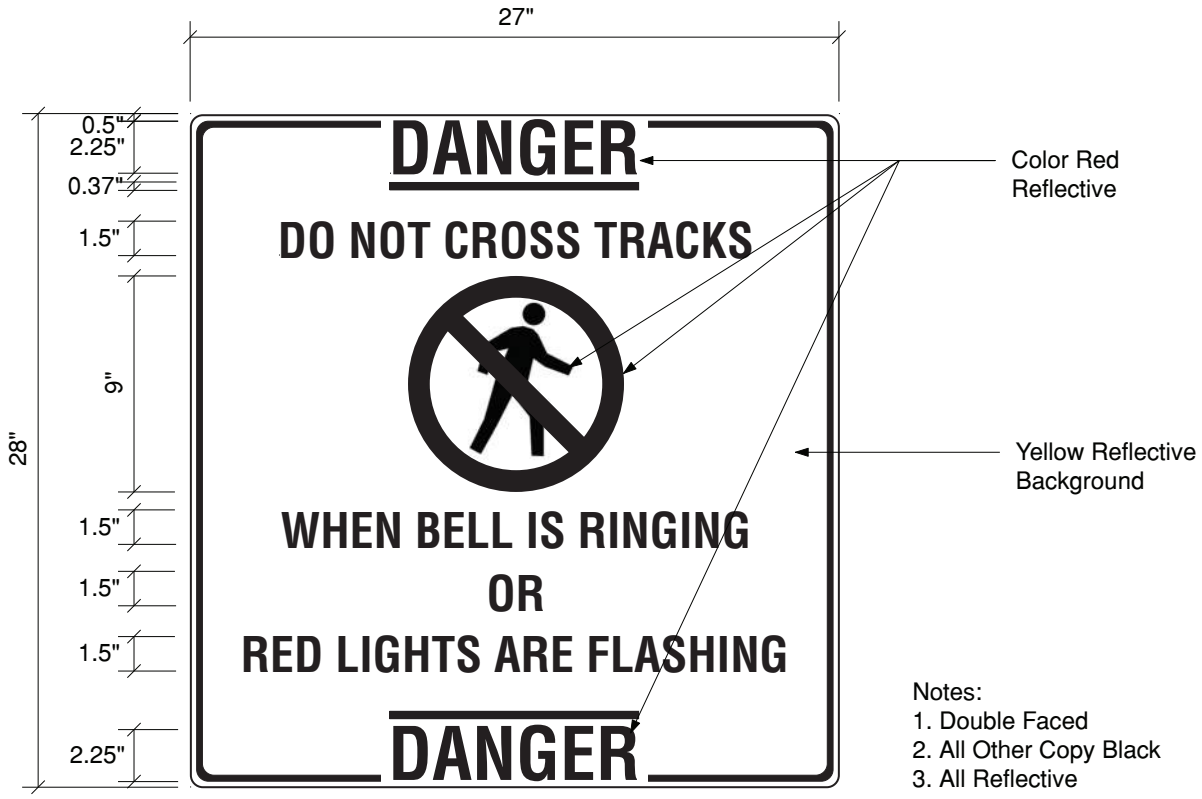
10A Danger Sign

10B Danger Sign

10C Plate Sign by the Square Foot

10D Warning Sign

SIGN TYPE 10A	Caution Sign - Do Not Cross Track Specifications
Panel size:	28” H x 27” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	Yellow Reflective
Symbol and Copy:	Exterior grade vinyl die-cut or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed
Copy Size:	2.25” and 1.5” Cap height
Copy Color:	Red Reflective and Black
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Symbol Size:	9” Diameter
Symbol Color:	Red Reflective


27"
28"
0.5"
2.25"
0.37"
1.5"
9"
1.5"
1.5"
1.5"
2.25"
DANGER
DO NOT CROSS TRACKS
WHEN BELL IS RINGING
OR
RED LIGHTS ARE FLASHING
DANGER
Color Red
Reflective
Yellow Reflective
Background
Notes:
1. Double Faced
2. All Other Copy Black
3. All Reflective

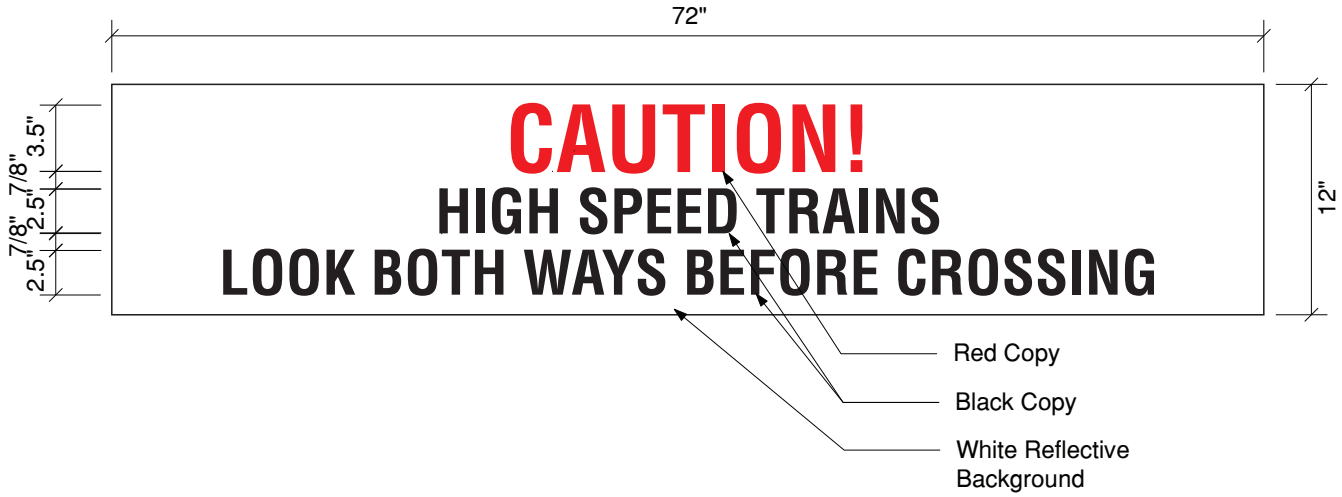
SIGN TYPE 10B	Caution Sign - Danger Specifications
Panel size:	9” H x 60” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White Reflective with black border
Copy:	Exterior grade vinyl die-cut or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed
Copy Size:	2” and 4” Cap height
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	Black and Red Reflective

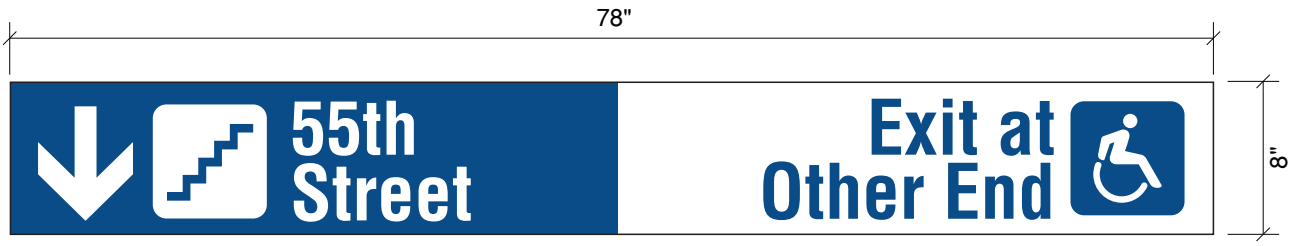

60"
0.5"
4"
2"
0.5"
DANGER
STAY BEHIND YELLOW LINE UNTIL TRAIN STOPS
9"
0.5” Black Border & Copy
Red Reflective Copy
White Reflective Background

SIGN TYPE 10C	Plate Sign by the Square Foot Specifications
Panel size:	12” H x 72” W* (Dimensions Vary - Measured by the Square Foot)
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White Reflective*
Copy:	Exterior grade vinyl die-cut or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed*
Copy Size:	2.5” and 3.5” Cap height*
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	Black and Red*

Note: Artwork, colors, reflectivity, messaging and fonts will vary. Panels may be either double or single sided.

**NOTE: Artwork, messaging, colors, reflectivity and panel size will vary.
Panel may be single or double sided.**





SIGN TYPE 10D	Caution Sign - Warning Specifications
Panel size:	24” H x 30” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	Yellow with Black border
Copy:	Exterior grade vinyl die-cut or silkscreened, with silkscreen protected by a clear topcoat containing UV inhibitors. Topcoat must be 11-19 degree gloss on 60 degree glossimeter.
Letterform:	Helvetica Bold Condensed
Copy Size:	3.5” Cap height
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	Black
Symbol:	Yield and Stop
Symbol Size:	11.25” H x 11.25” W
Symbol Color:	Red Reflective and White Reflective
Arrow:	Custom
Arrow Size:	3.5” H x 15.25”
Arrow Color:	Black

Pedestrian & Cyclist Warning Sign
YIELD - LOOK FOR TRAINS"

ALTERNATE USE OF STOP SIGN

Description:

In addition to Sign Types 1-10, specifications are provided for sign types specific to the Downtown Terminal: A1, A2, B1, B2, C1 and R.

All symbols and arrows used on Downtown Terminal signs should be consistent with those used on other signs in the Program.

Following are general specifications for these sign types as well as schematics showing sign sizes, messages, and placement.

Sign Types:

A1 Large Ceiling Directional

A2 Medium Ceiling Directional

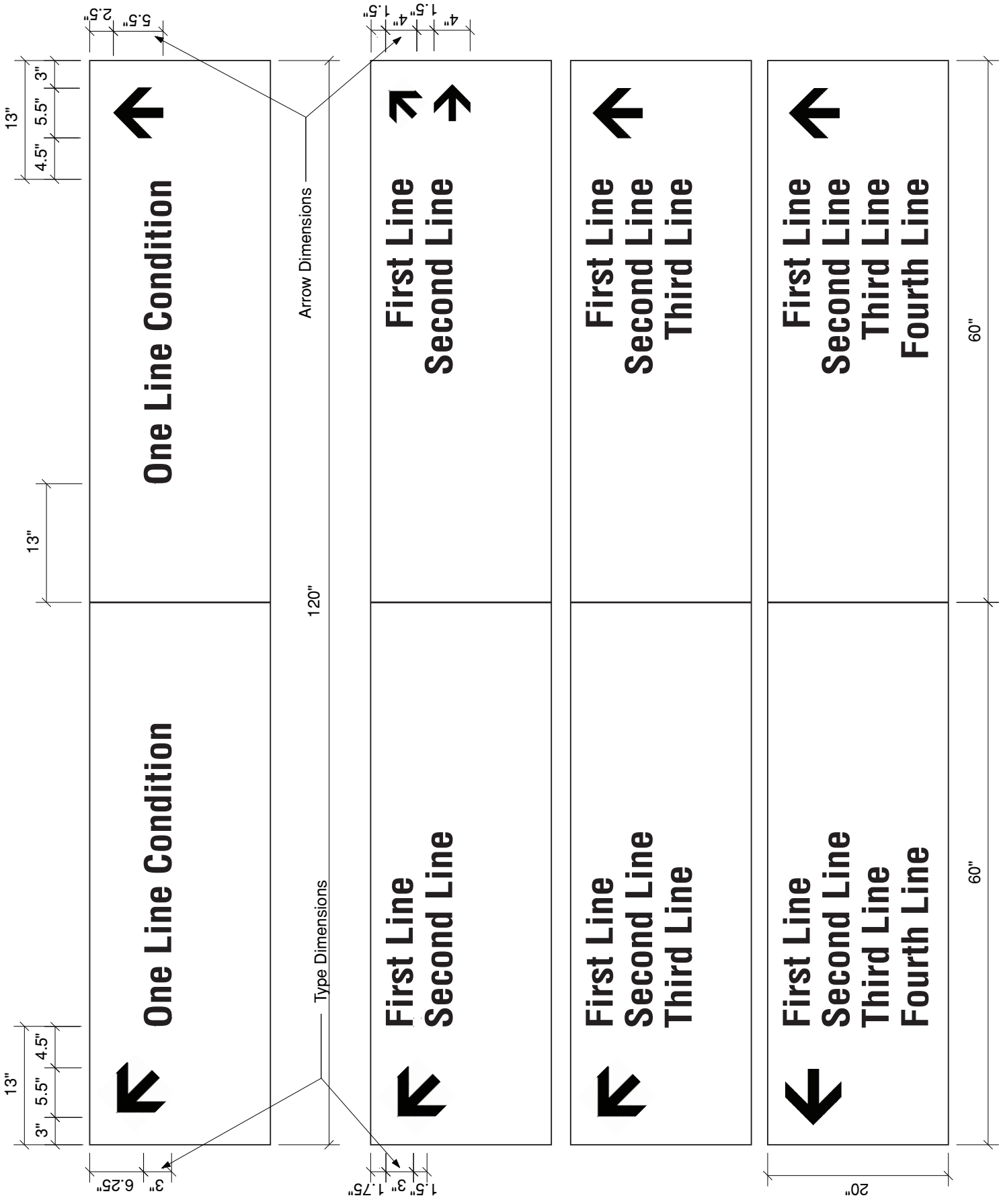
B1 Small Ceiling Identification / Directional

B2 Small Ceiling Identification / Directional

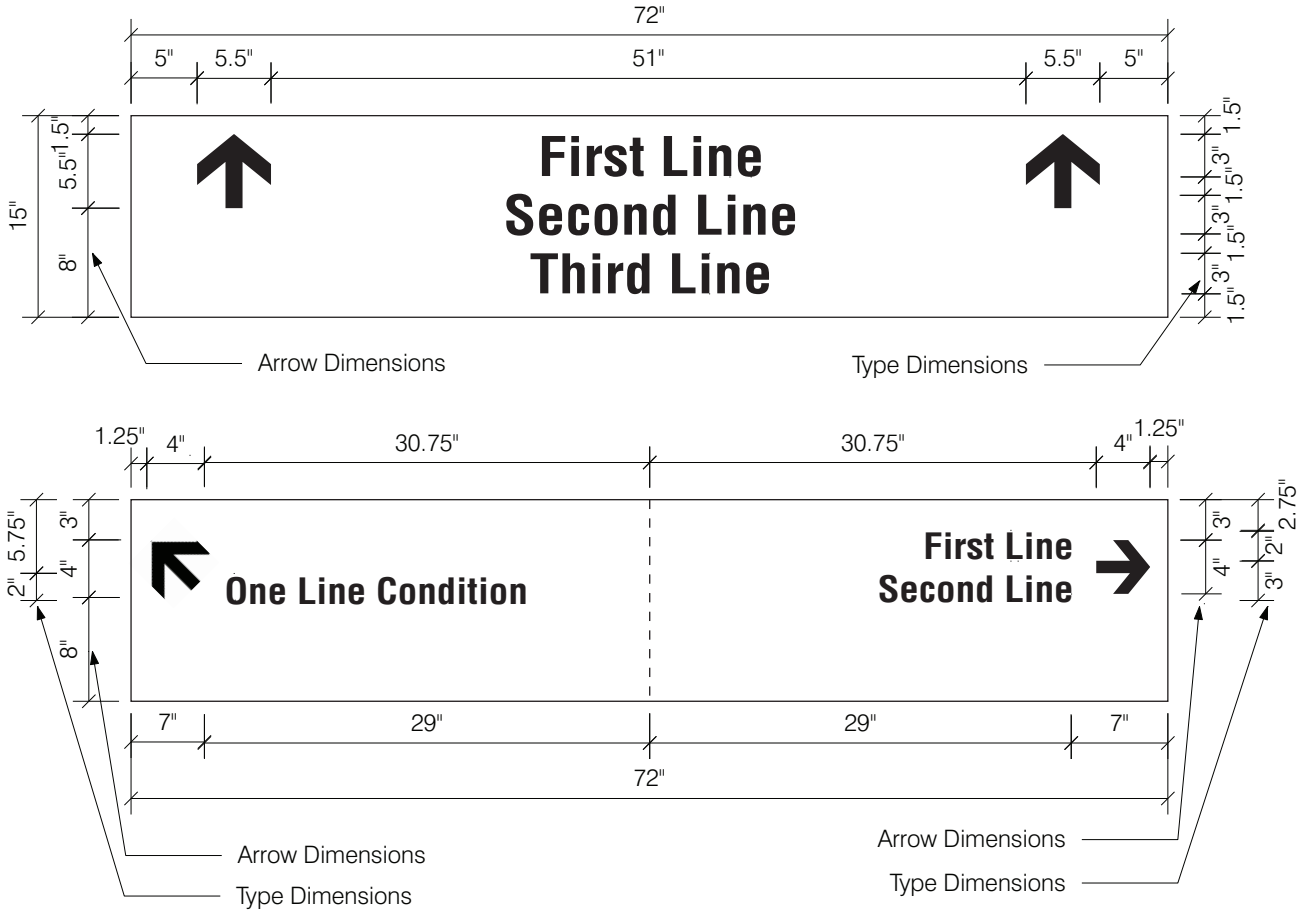
C1 Secondary Identification / Directional

R Tickets

Size:	20” H X 120” W (Ceiling height should be checked to ensure proper clearance under sign. A low ceiling may require a sign height of less than 20”.)
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy and Arrows:	Vinyl die-cut graphics
Letterform:	Helvetica Bold Condensed
Copy Size:	3” Cap height
Arrow Size:	5 1/2” x 6” and 4” x 4” x 4 1/4” (see schematics)
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Mounting:	Ceiling mounted (Specifications for supports and hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)

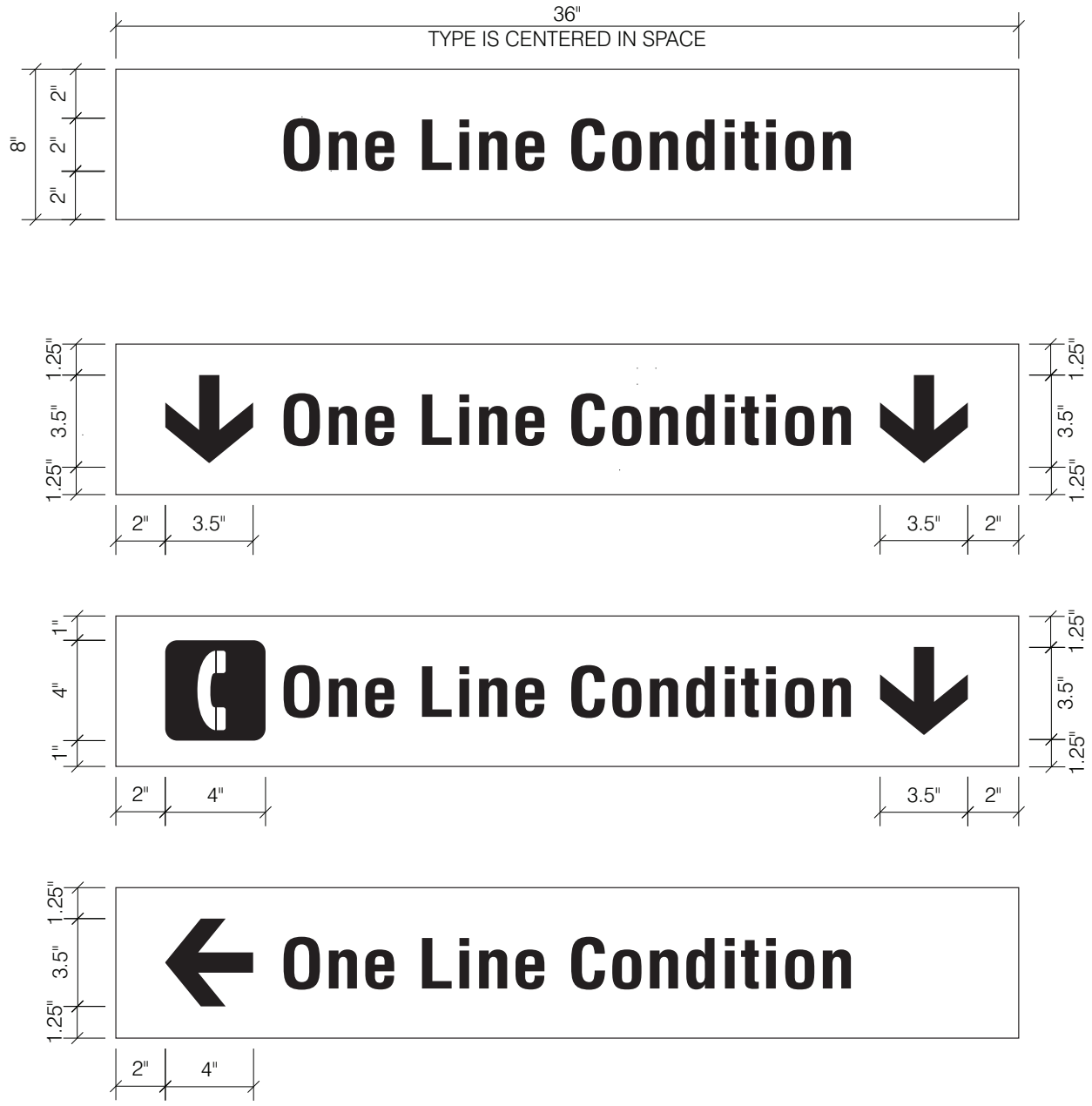

One Line Condition
First Line
Second Line
First Line
Second Line
Third Line
First Line
Second Line
Third Line
Fourth Line
One Line Condition
First Line
Second Line
First Line
Second Line
Third Line
First Line
Second Line
Third Line
Fourth Line
Arrow Dimensions
Type Dimensions
120"
60"
60"
20"
13"
13"
13"
3"
5.5"
4.5"
4.5"
5.5"
3"
5.5"
2.5"
4"
1.5"
1.5"
3"
6.25"
3"
1.5"
1.75"

Size:	15” H X 72” W (Ceiling height should be checked to ensure proper clearance under sign. A low ceiling may require a sign height of less than 15”.)
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy and Arrows:	Vinyl die-cut graphics
Letterform:	Helvetica Bold Condensed
Copy Size:	3” Cap height and 2” Cap height
Arrow Size:	5 1/2” and 4” (see schematics)
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Mounting:	Ceiling mounted and flush mounted (Specifications for supports and hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)


72"
5"
5.5"
51"
5.5"
5"
15"
1.5"
5.5"
8"
First Line
Second Line
Third Line
1.5"
3"
1.5"
3"
1.5"
3"
1.5"
Arrow Dimensions
Type Dimensions
1.25"
4"
30.75"
30.75"
4"
1.25"
5.75"
2"
3"
4"
8"
One Line Condition
First Line
Second Line
3"
4"
2"
3"
2.75"
7"
29"
29"
7"
72"
Arrow Dimensions
Type Dimensions
Arrow Dimensions
Type Dimensions

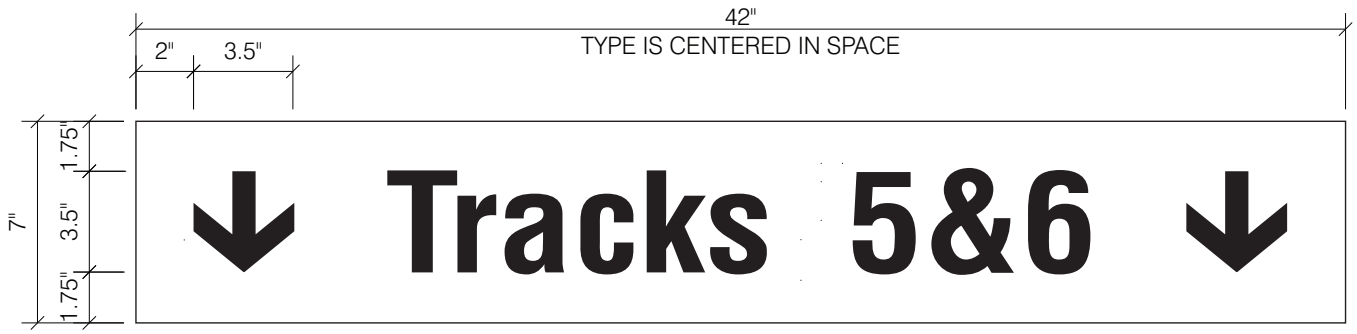
Sign Type B1 - Small Ceiling Identificational / Directional Specifications

Size:	6” H X 36” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	Finish both sides / To match PMS 301
Copy and Arrows:	Vinyl die-cut graphics
Letterform:	Helvetica Bold Condensed
Copy Size:	2” Cap height
Symbol Size:	4”
Arrow Size:	2 1/2” and 3 3/4”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol and Arrow Color:	White
Mounting:	Ceiling mounted and flush mounted (Specifications for supports and hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)


36"
TYPE IS CENTERED IN SPACE
8"
2"
2"
2"
One Line Condition
1.25"
3.5"
1.25"
One Line Condition
2"
3.5"
3.5"
2"
1"
4"
1"
One Line Condition
2"
4"
3.5"
2"
One Line Condition
2"
4"

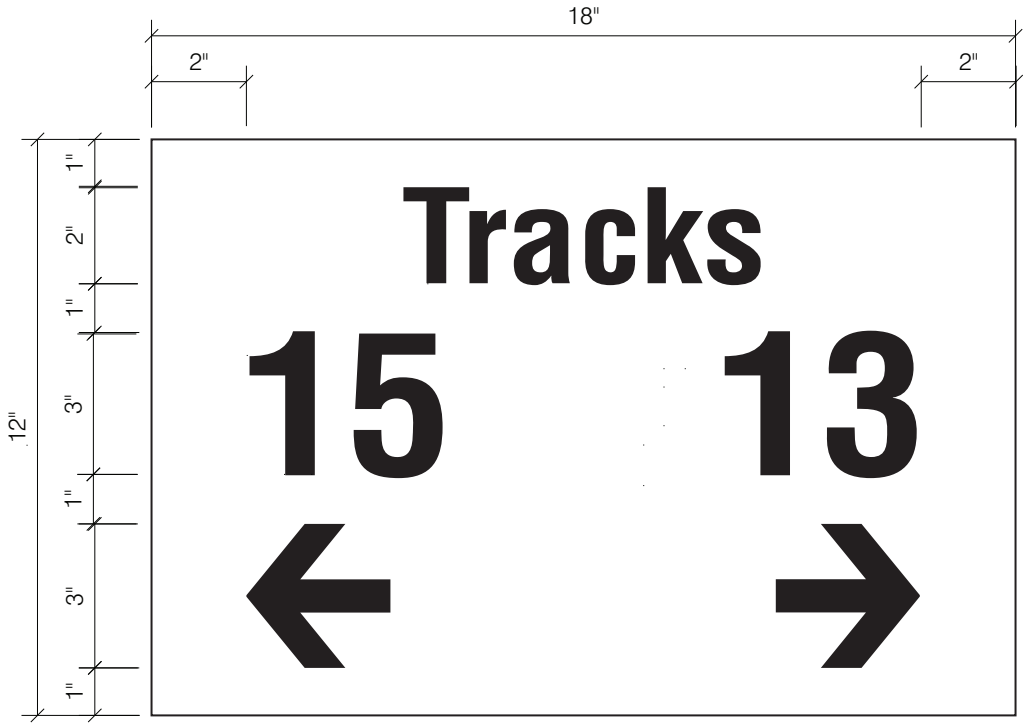
Sign Type B2 - Small Ceiling Identificational / Directional Specifications

Size:	7” H X 42” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	Finish both sides / To match PMS 301
Copy and Arrows:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3 1/2” Cap height
Arrow Size:	3 1/2”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Arrow Color:	White
Mounting:	Ceiling mounted and flush mounted (Specifications for supports and hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)


42"
TYPE IS CENTERED IN SPACE
2"
3.5"
7"
1.75"
3.5"
1.75"
Tracks 5&6

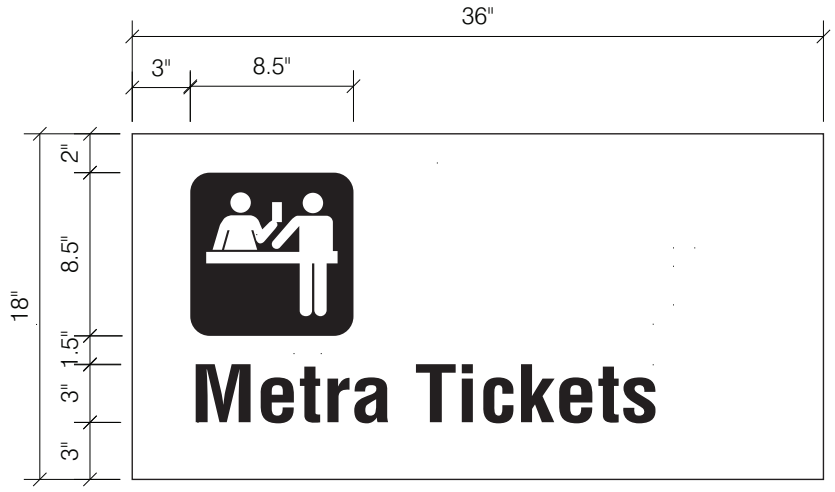

2"
3.5"
7"
1.75"
3.5"
1.75"
Track 2

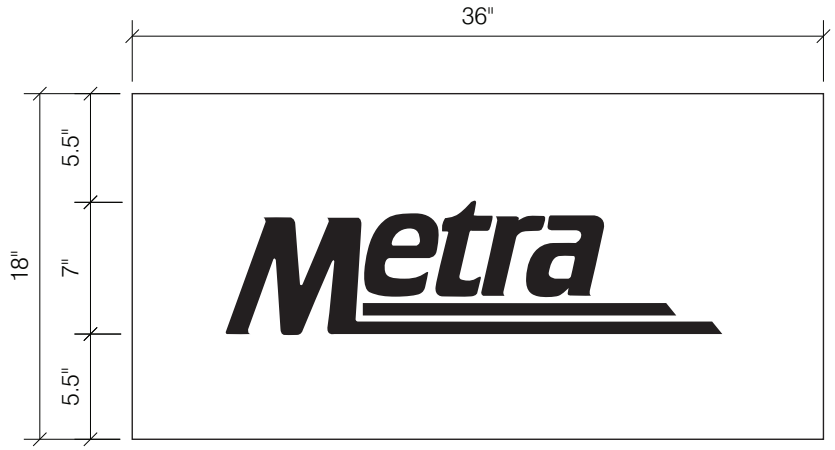
Size:	12” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy and Arrows:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2” and 3” Cap height
Arrow Size:	3”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Arrow Color:	White


18"
2"
2"
12"
1"
2"
1"
3"
1"
3"
1"
Tracks
15
13

Sign Type R - Tickets
Specifications

Size:	18” H X 36” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane - interior applications do not require UV inhibitors, exterior applications do require UV inhibitors. Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	1 or 2 sides / To match PMS 301
Copy and Arrows:	Silkscreened with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3” Cap height
Symbol Size:	8.5”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol Color:	Blue (PMS 301) on White background
Mounting:	Ceiling or Flush Mounted (Specifications for hardware will vary based on existing conditions of sign location. Fabricator to submit proposed specifications for hardware to Metra for approval.)


36"
3"
8.5"
18"
2"
8.5"
1.5"
3"
3"
Metra Tickets


36"
18"
5.5"
7"
5.5"
Metra

Description:

In addition to Sign Types 1-10 and Downtown Terminal Sign Types, specifications are provided for sign types specific to the Parking Signages.

All symbols and arrows used on Parking Signage should be consistent with those used on other signs in the Program.

Following are general specifications for these sign types as well as schematics showing sign sizes, messages, and placement.

Sign Types:

P-1A Entrance - Large Identification

P-1B Entrance - Large Identification / Directional

P-2A One Way - Small Directional (R6-2 L)

P-2B One Way - Small Directonal (R6-2 R)

P-2C One Way - Medium Directional (R6-2 L)

P-2D No Parking - Small Identification (R7-1)

P-2E Keep Left - Medium Directional (R4-8)

P-2F Keep Right - Medium Directional (R4-7)

P-2G Stop - Large Directional (R1-1)

P-2H Do Not Enter - Large Directional (R5-1)

P-3A Parking Space Number - Small Identification

P-4A Permit Parking - Small Directional

P-4B Permit Only - Small Identification

P-4C Permit Only - Medium Identification

P-4D Permit Only - Large Identification

P-5A Daily Fee Parking - Small Directional

P-5B All Day Parking - Medium Identification

P-5C All Day Parking - Medium Identification

P-5D All Day Parking - Medium Identification

P-5E Coin Box - Medium Identification

P-5F Dailiy Commuter Parking - Medium Identification

P-5G Coin Box - Medium Identification

P-5H Coin Box - Medium Identification

P-5J Commuter Parking - Large Identification

Sign Types:

P-5K Coin Box - Medium Identification

P-6A Kiss ‘N Ride - Small Identification / Directional

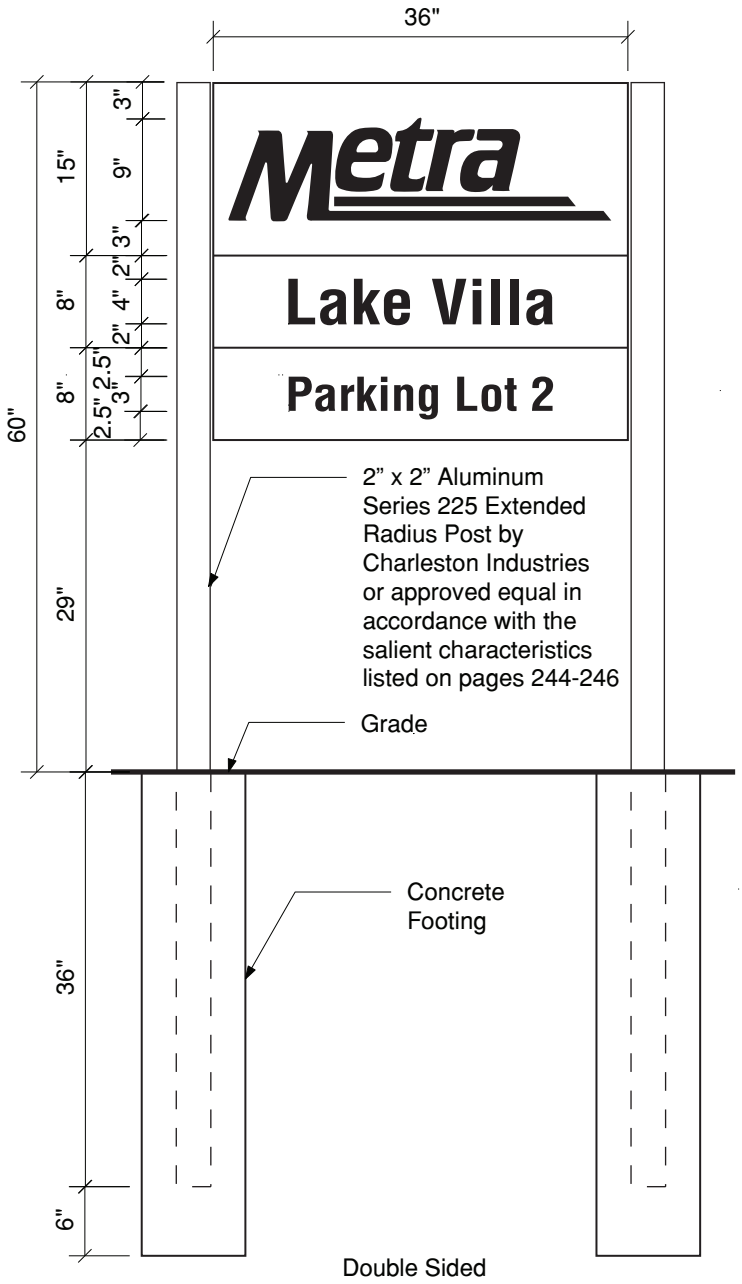
P-6B Compact Care Only - Small Identification / Directional

P-7A Reserved Parking - Small Identification (R7-8 & R7-I101)

P-8A Patrons Only - Samll Identification

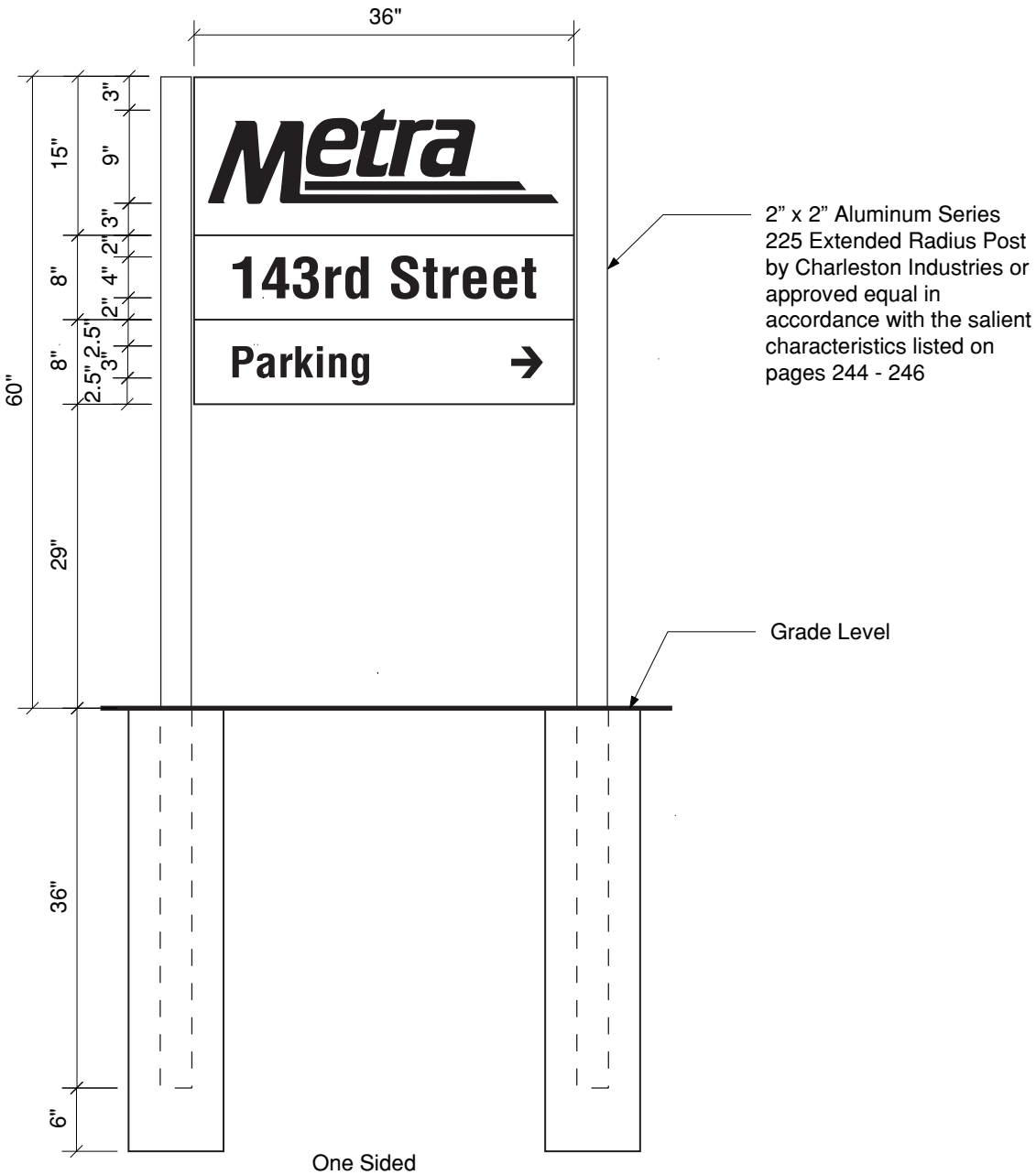
P-8B Parking - Small Directional

Post Height:	60” from grade to top of sign
Post Material:	2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics listed on pages 244 - 246.
Post & Reveal Color:	Black anodized finish
Size:	31” H X 36” W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant (see page on 61).
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed Upper Lower Case
Copy Size:	4” and 3” Cap height
Copy Color:	White
Mounting:	All sign panels slide and lock into posts. Panels must be capable of being removed and replaced on site to keep maintenance and replacement costs to a minimum. (See page 244 - 246 for details)


36"
60"
3"
15"
9"
3"
2"
4"
2"
8"
2.5"
2.5"
3"
8"
29"
36"
6"
Metra
Lake Villa
Parking Lot 2
2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics listed on pages 244-246
Grade
Concrete Footing
Double Sided

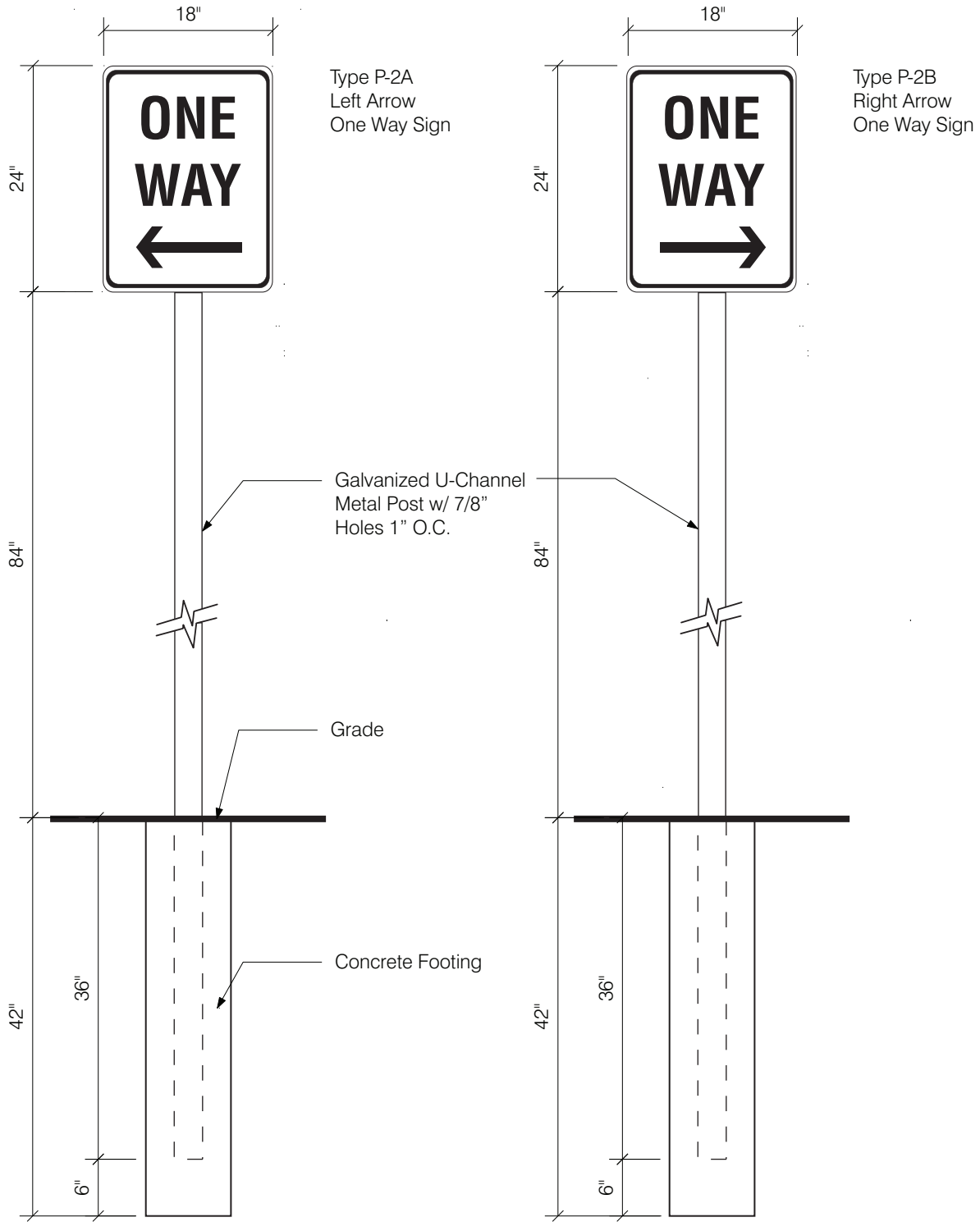
Post Height:	60” from grade to top of sign
Post Material:	2” x 2” Aluminum Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the salient characteristics listed on pages 244 - 246.
Post & Reveal Color:	Black anodized finish
Size:	31” H X 36” W
Material:	Sign panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather-resistant (see page on 61).
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy and Arrow:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed Upper Lower Case
Copy Size:	4” and 3” Cap height
Copy and Arrow Color:	White
Arrow Size:	3”
Mounting:	All sign panels slide and lock into posts. Panels must be capable of being removed and replaced on site to keep maintenance and replacement costs to a minimum. (See page 244 - 246 for details)

Sign Type P-1B Entrance - Large Identificational / Directional Schematic



Mounting Height:	84” from grade to bottom of sign
Size:	24” H X 18” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy and Arrow:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed
Copy and Arrow Color:	Black
Mounting:	Post mounted (See page 253 for detail) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

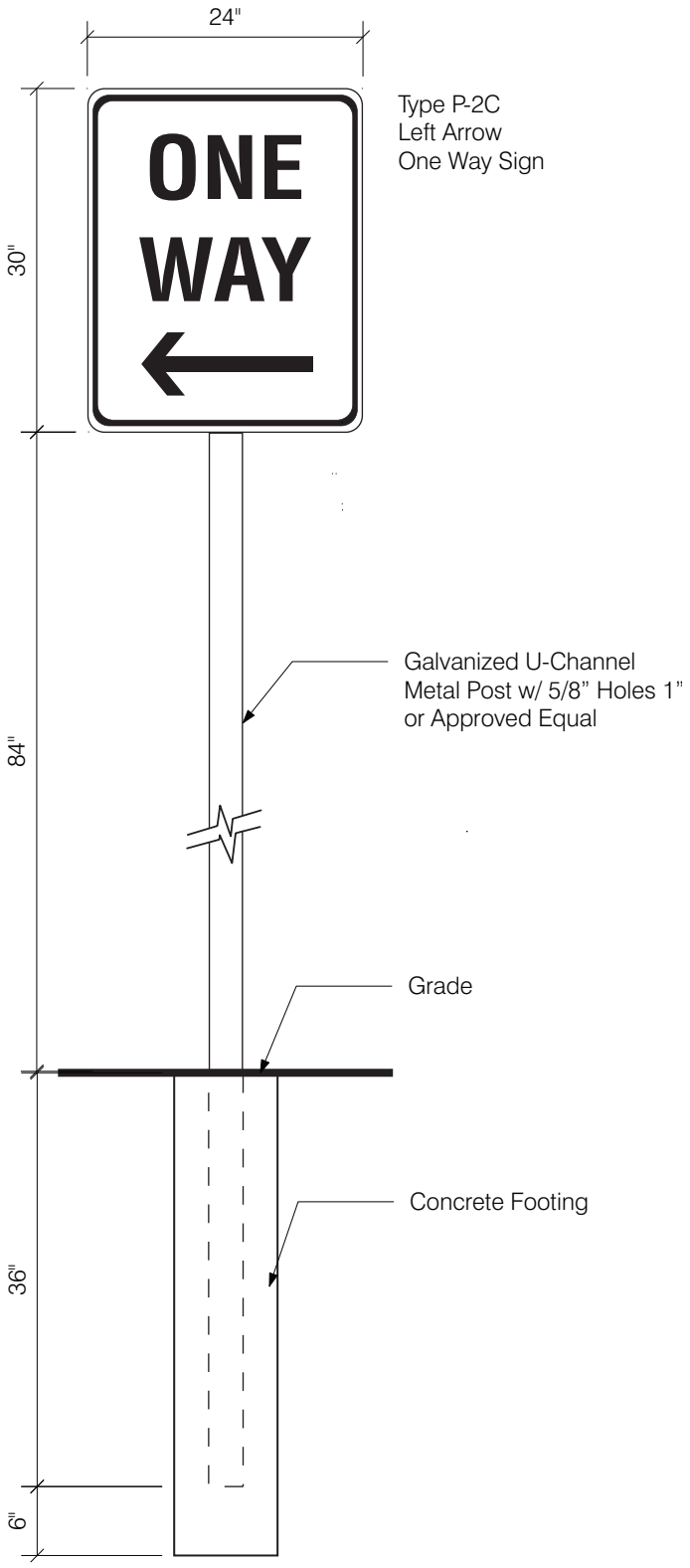
These sign types are base on Manual on Uniform Traffic Control Device manual By US Department of Transportation. The graphics are representational. Dimensions for copy, arrows, symbols, and spacing shall be based on latest version of MUTCD manual.



Mounting Height:	84” from grade to bottom of sign
Size:	30” H X 24” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy and Arrow:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed
Copy and Arrow Color:	Black
Mounting:	Post mounted (See page 253 for detail) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-2C One Way - Medium Directional (R6-2 L) Schematic

This sign type is base on Manual on Uniform Traffic Control Device manual By US Department of Transportation. The graphic is representational. Dimensions for copy, arrows, symbols, and spacing shall be based on latest version of MUTCD manual.



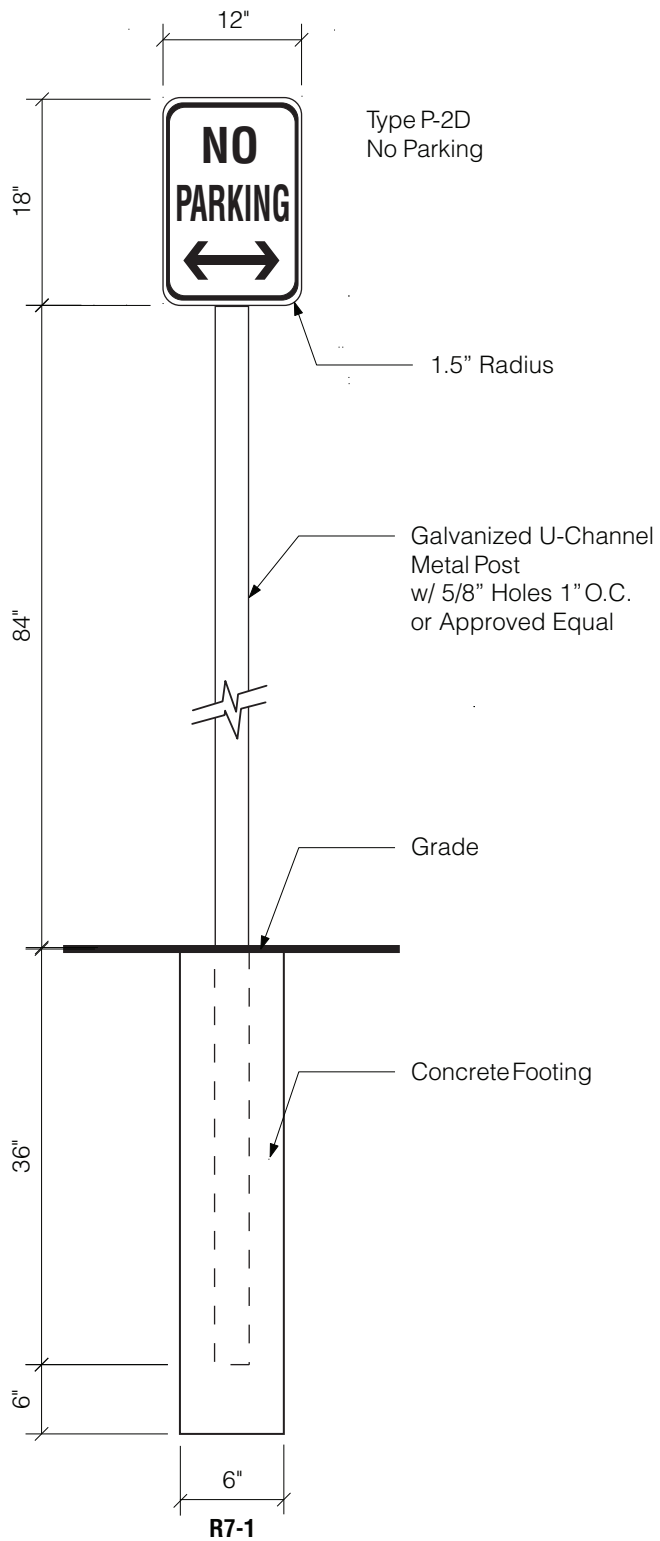
R6-2 L

Sign Type P-2D No Parking - Small Identification (R7-1)
Specifications

Mounting Height:	84” from grade to bottom of sign
Size:	18” H X 12” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy and Arrow:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed
Copy Color:	Red reflective
Arrow Color:	Black
Mounting:	Post mounted (See page 253 for detail) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-2D No Parking - Small Identificational (R7-1) Schematic

This sign type is base on Manual on Uniform Traffic Control Device manual By US Department of Transportation. The graphic is representational. Dimensions for copy, arrows, symbols, and spacing shall be based on latest version of MUTCD manual.

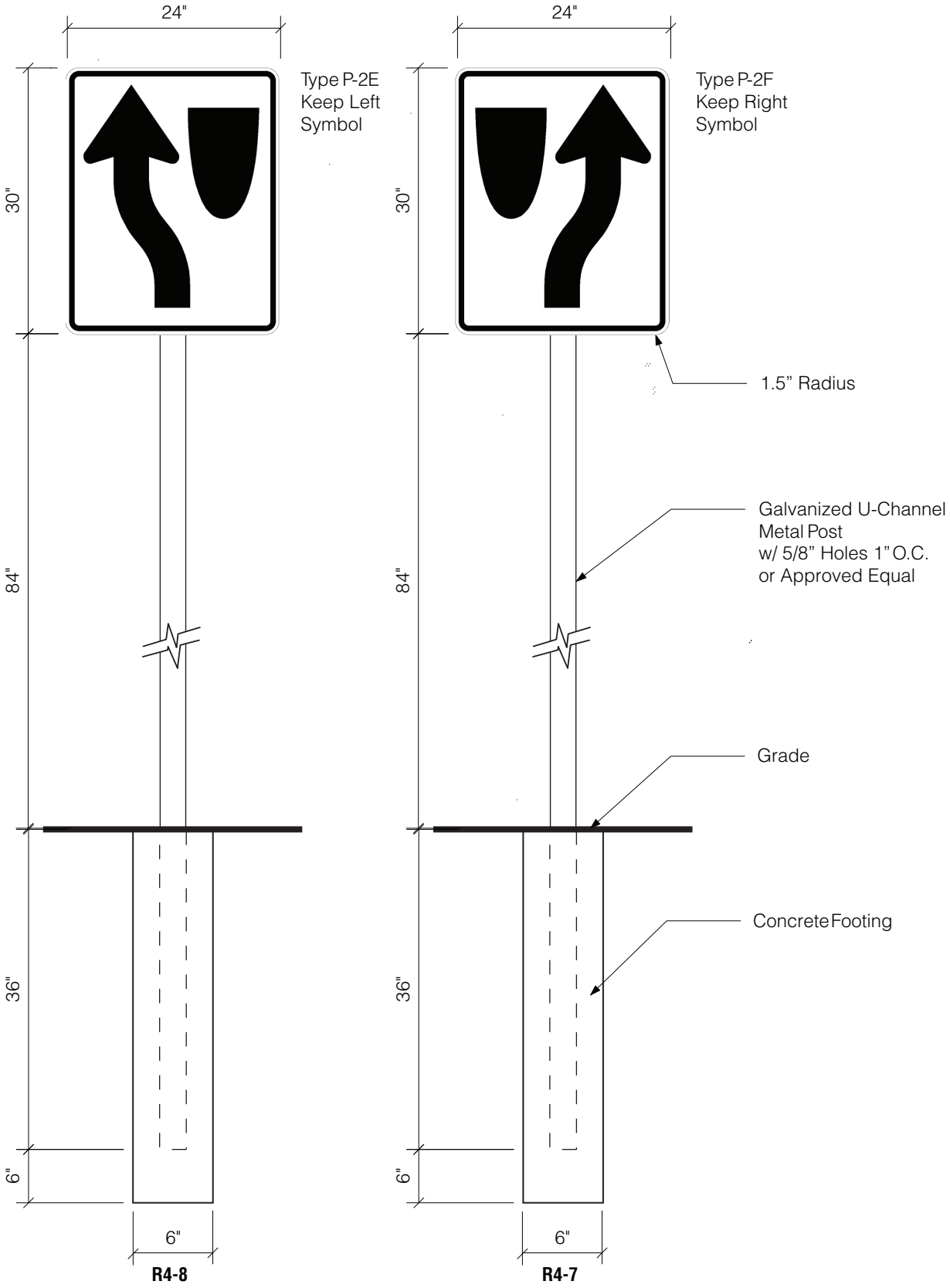


R7-1

Mounting Height:	84” from grade to bottom of sign
Size:	30” H X 24” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	High Intensity Prismatic Refletive White
Symbol and Arrow:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Symbol and Arrow Color:	Black
Mounting:	Post mounted (See page 253 for detail) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-2E & P-2F Keep Left & Right - Medium Directional (R4-8 & R4-7) Schematic

This sign type is base on Manual on Uniform Traffic Control Device manual By US Department of Transportation. The graphic is representational. Dimensions for copy, arrows, symbols, and spacing shall be based on latest version of MUTCD manual.

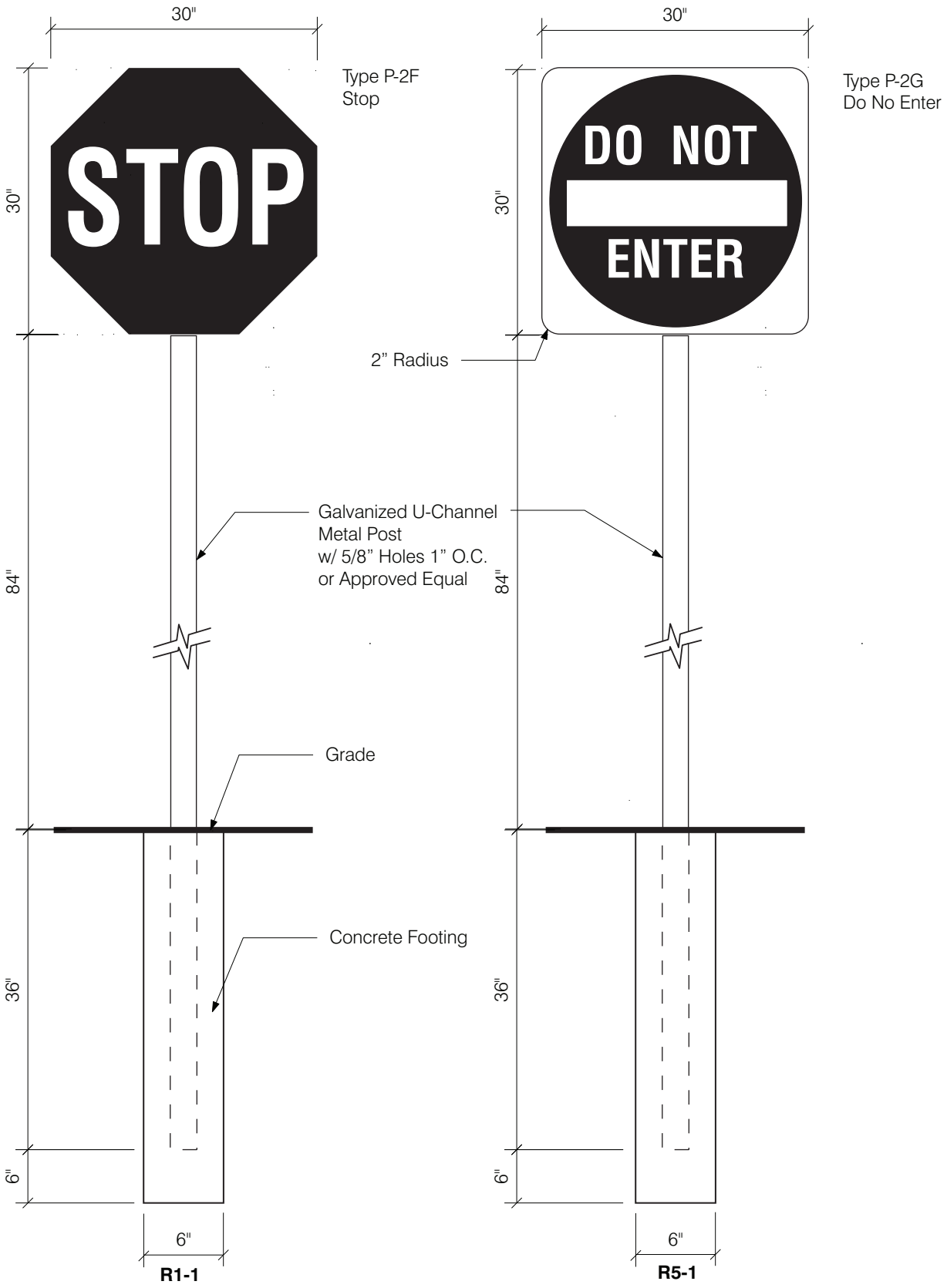


Sign Type P-2G & H - Large Directional (R1-1 & R5-1) Specifications

Mounting Height:	84” from grade to bottom of sign
Size:	30” H X 30” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	Red Reflective
Copy:	Exterior grade vinyl die-cut letters or silk-screened, with silk-screen protected by a clear topcoat containing UV inhibitors. Top coat must be 11 - 19 degree gloss on 60 degree glossmeter.
Letterform:	Helvetica Bold Condensed
Copy Color:	White Reflective
Mounting:	Post mounted (See page 253 for detail) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-2F & G - Large Directional (R1-1 & R5-1)
Schematic

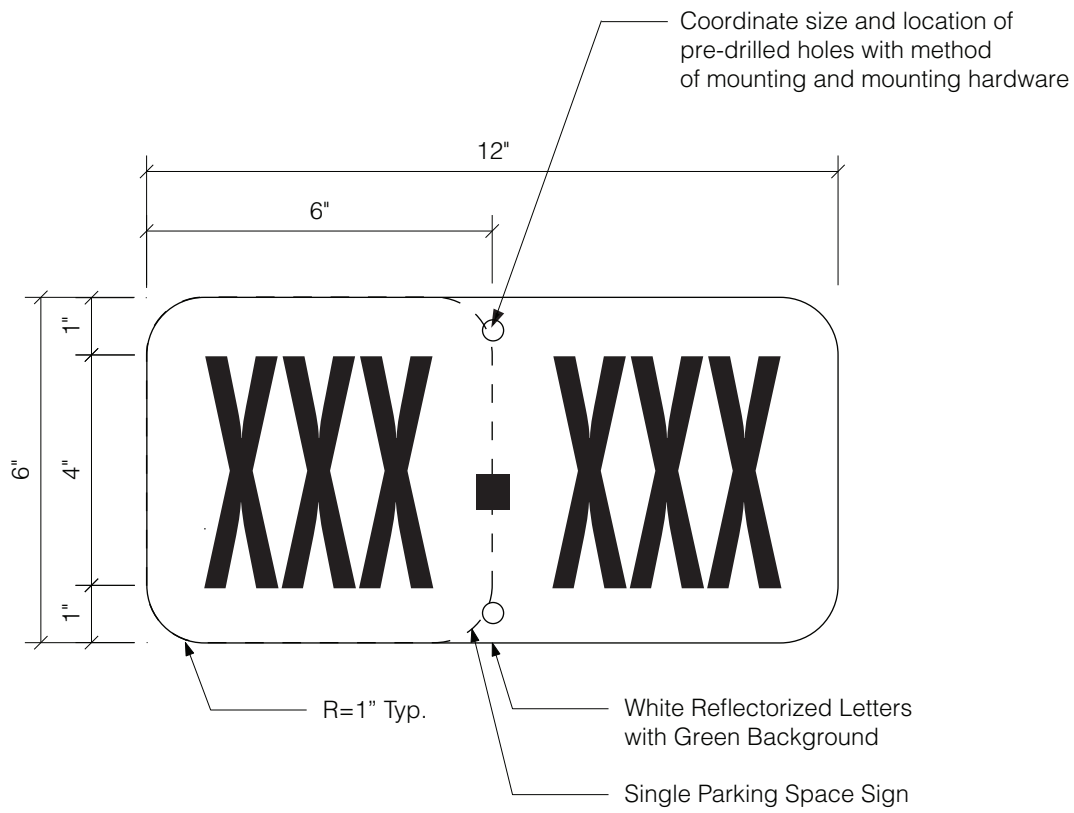
These sign types are base on Manual on Uniform Traffic Control Device manual By US Department of Transportation. The graphics are representational. Dimensions for copy, arrows, symbols, and spacing shall be based on latest version of MUTCD manual.



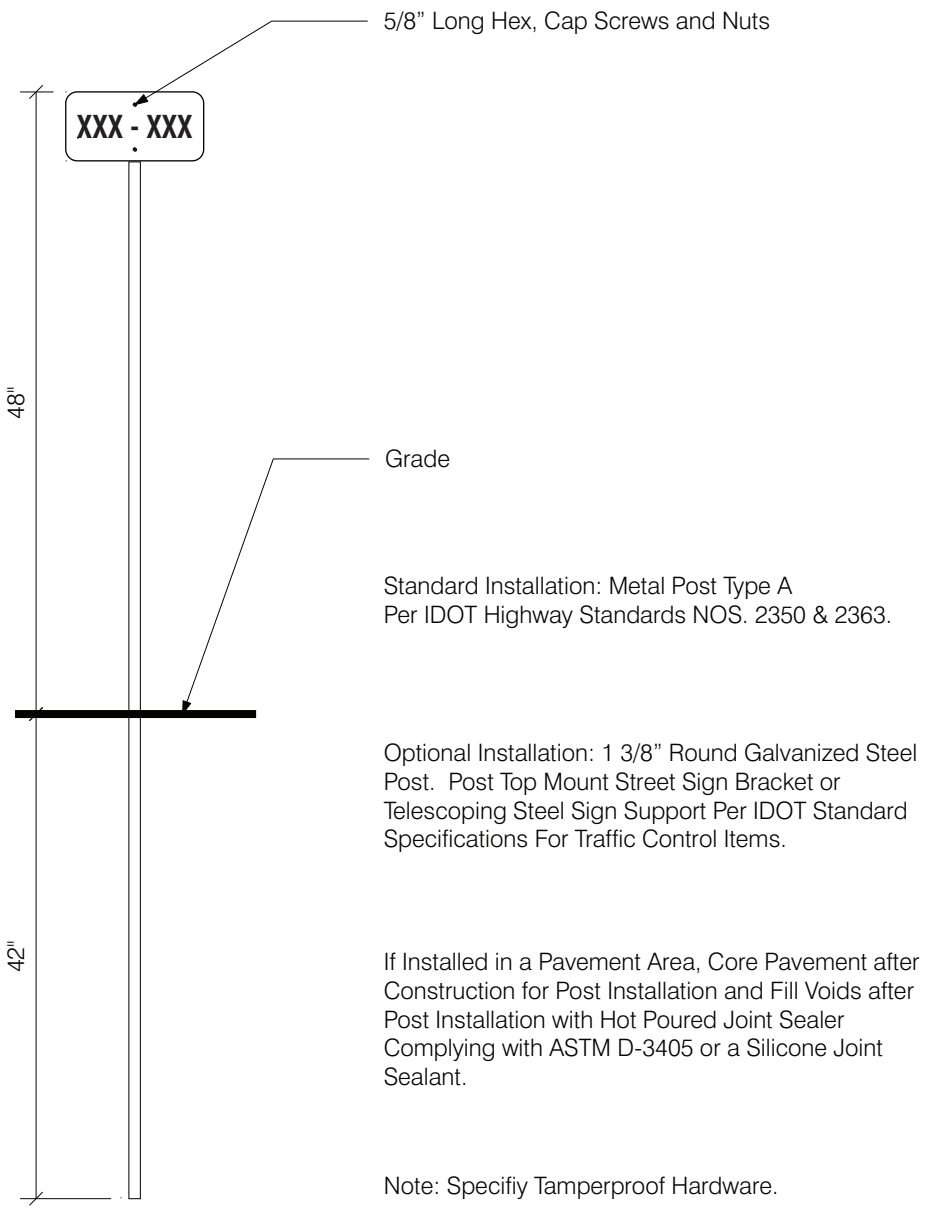
Sign Type P-3A Parking Space Number - Small Identificational Specifications

Size:	6” H X 12” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	Green reflective (or other)
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Color:	White reflective
Mounting:	Post mounted and Aerial Mounted (Specifications for supports and hardware will vary based on sign location. Fabricator to submit proposed specifications for supports and hardware to Metra for approval.)

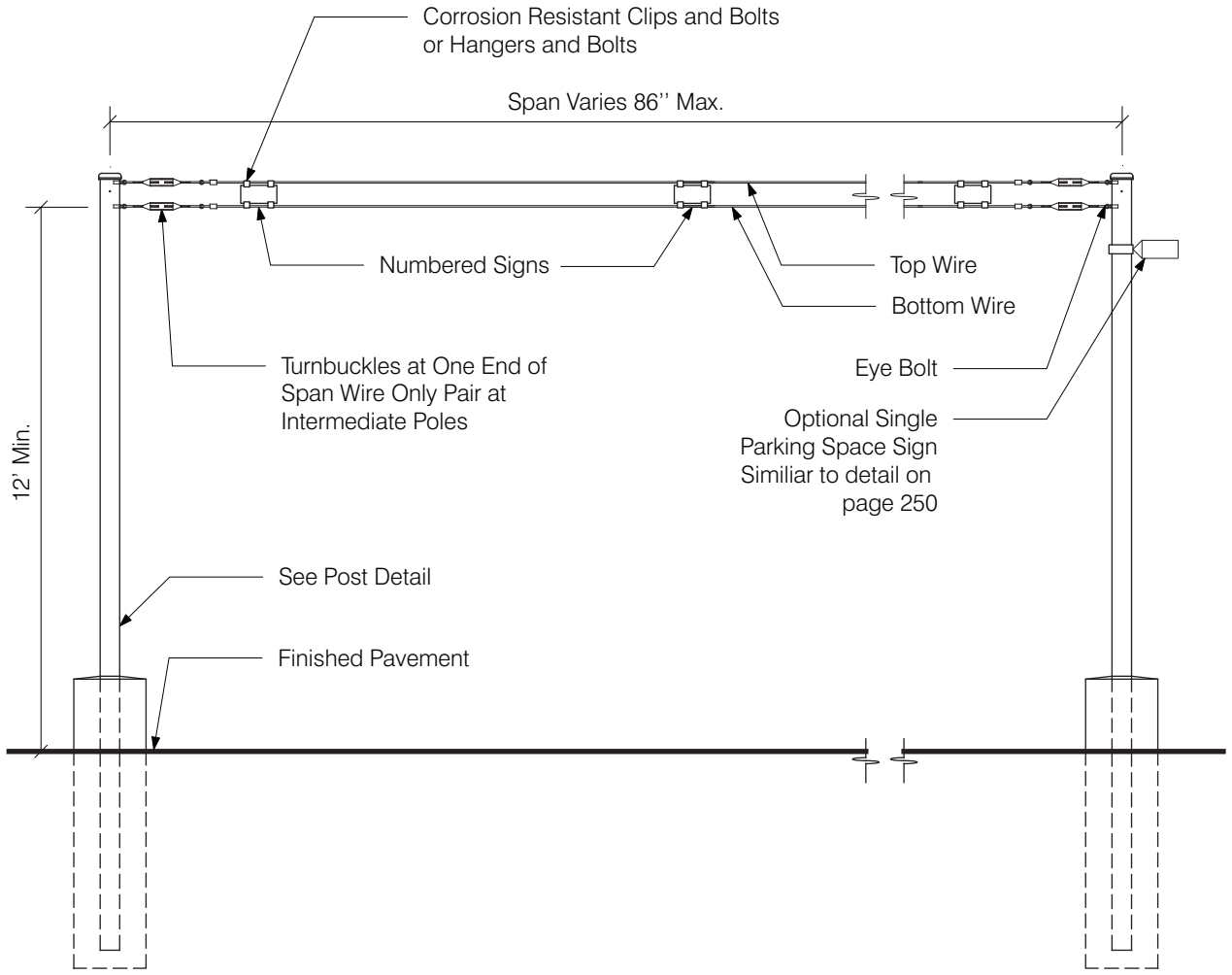
Sign Type P-3A Parking Space Number - Small Directional Schematic



Note: On large sectionalized lots color coding of signs may be considered other background color could be: brown, blue, or (check for availability) purple, strong yellow-green, light blue and coral. For the lighter colors reflectorized the background and use black letters and borders.

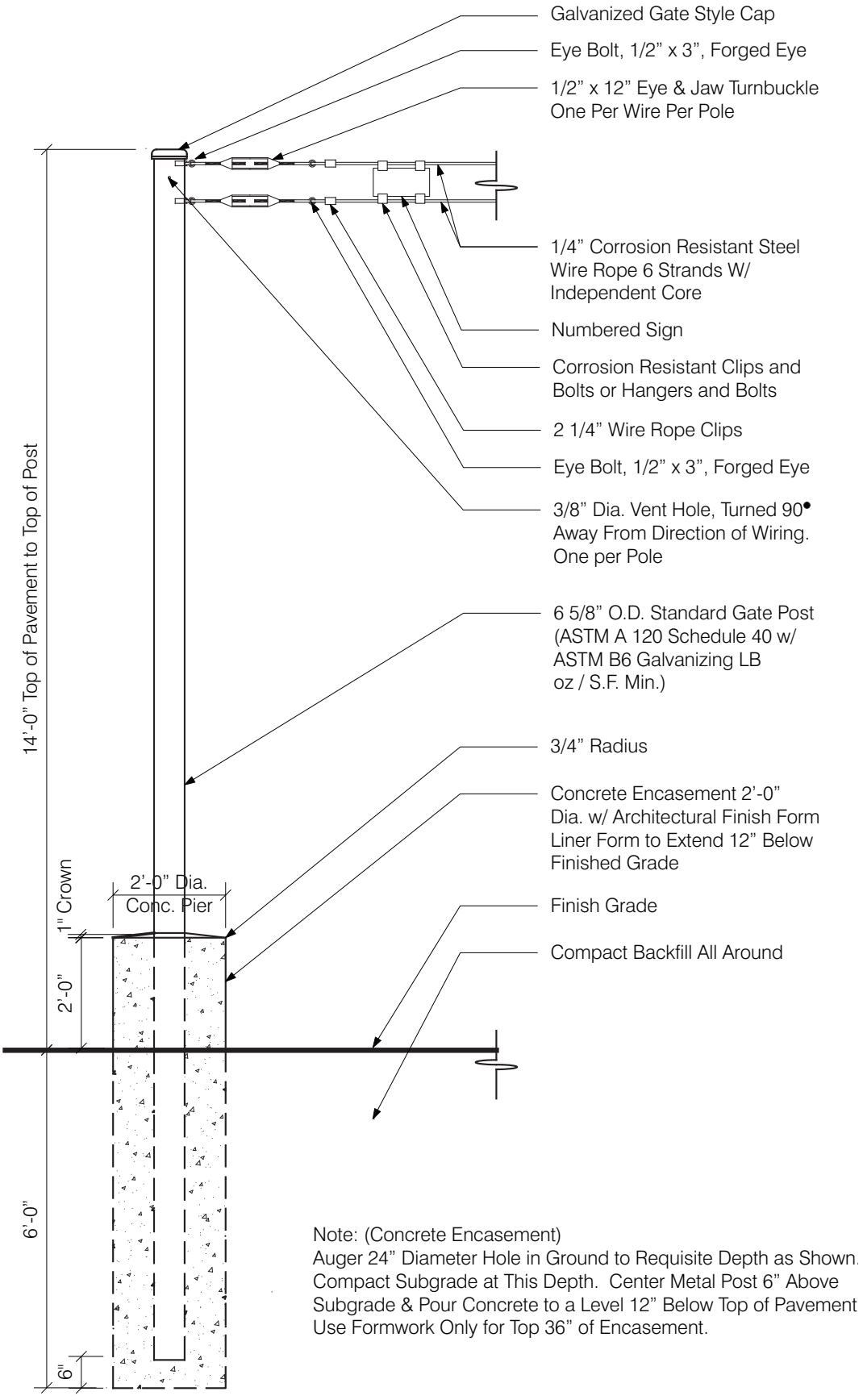


PARKING SPACE NUMBER SIGNS INSTALLATION DETAIL
(POST MOUNTING - FOR PERIMETER SPACES)



PARKING SPACE NUMBER SIGNS AERIAL MOUNT

Sign Type P-3A Parking Space Number - Small Directional
Schematic - Aerial Mounted Detail



Note: (Concrete Encasement)
Auger 24" Diameter Hole in Ground to Requisite Depth as Shown. Compact Subgrade at This Depth. Center Metal Post 6" Above Subgrade & Pour Concrete to a Level 12" Below Top of Pavement Use Formwork Only for Top 36" of Encasement.

PARKING SPACE NUMBER SIGNS AERIAL MOUNT POST DETAIL

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2”
Copy and Border Color:	Green
Arrow Size:	2”
Arrow Color:	Green
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

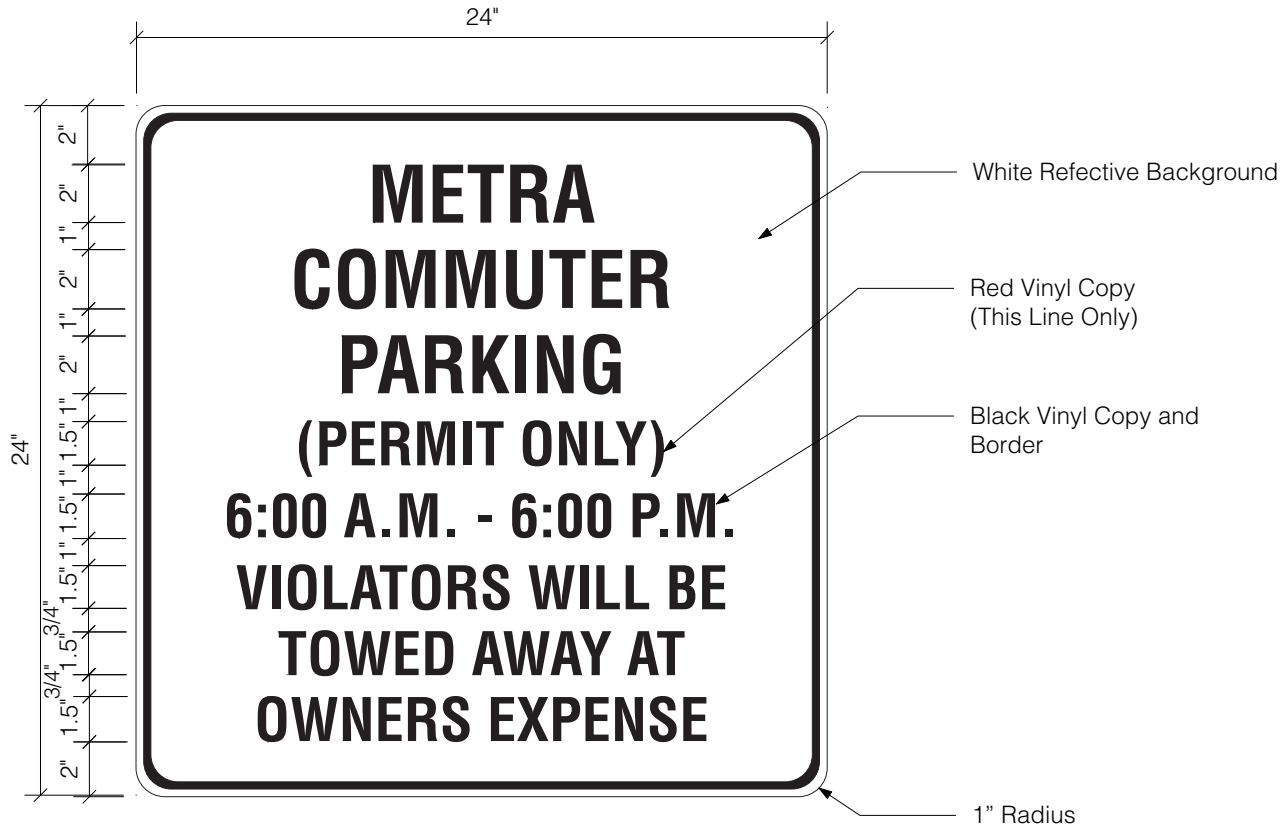
Sign Type P-4A Permit Parking - Small Identificational / Directional Schematic

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	1.5” and 1”
Copy and Border Color:	Green
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-4B Permit Only - Small Identificational Schematic

Sign Type P-4C Permit Only - Medium Identificational Specifications

Size:	24” H X 24” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2” and 1.5”
Copy and Border Color:	Black and Red Vinyl
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)


24"
24"
2"
2"
1"
2"
1"
2"
1"
1.5"
1"
1.5"
1"
1.5"
1"
1.5"
3/4"
1.5"
3/4"
1.5"
2"
METRA
COMMUTER
PARKING
(PERMIT ONLY)
6:00 A.M. - 6:00 P.M.
VIOLATORS WILL BE
TOWED AWAY AT
OWNERS EXPENSE
White Refective Background
Red Vinyl Copy
(This Line Only)
Black Vinyl Copy and
Border
1" Radius

Size:	36” H X 36” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	4”
Copy and Border Color:	Black
Mounting:	Post or wall mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)


36"
36"
3"
4"
2.5"
4"
2.5"
4"
2.5"
4"
2.5"
4"
3"
METRA
COMMUTER
PARKING
BY PERMIT
ONLY
Black Letters and Borders on White
Reflectorized Background
1" Radius

Sign Type P-5A Daily Fee Parking - Small Identificational / Directional Specifications

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2”
Copy and Border Color:	Green
Mounting:	Post or wall mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5A Daily Fee Parking - Small Identificational / Directional Schematic

Sign Type P-5B All Day Parking - Medium Identificational Specifications

Post Material:	2” x 2” Extruded aluminum
Post & Reveal Color:	Black anodized finish
Size:	24” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3” and 1.5”
Copy and Border Color:	Green reflective
Mounting:	Post or wall mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5B All Day Parking - Medium Identificational Schematic

Note: Designer to verify with station location for parking cost.

Sign Type P-5C All Day Parking - Medium Identificational Specifications

Post Material:	2” x 2” Extruded Aluminum
Post & Reveal Color:	Black anodized finish
Size:	24” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3” and 1.5”
Copy and Border Color:	Green reflective
Mounting:	Post or wall mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5C All Day Parking - Medium Identificational Schematic

Note: Designer to verify with station location for parking cost.

Post Material:	2” x 2” Extruded aluminum
Post & Reveal Color:	Black anodized finish
Size:	24” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3” and 1.5”
Copy and Border Color:	Green reflective
Mounting:	Post or wall mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

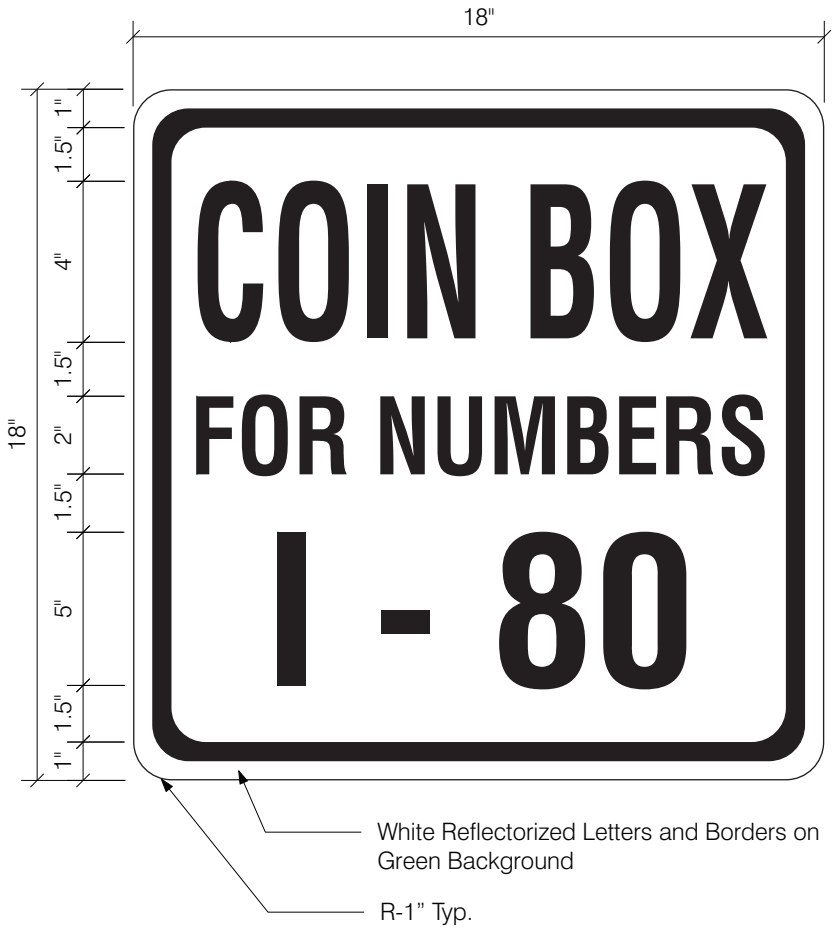
Sign Type P-5D All Day Parking - Medium Identificational Schematic

Note: Designer to verify with station location for parking cost.

Sign Type P-5E Coin Box - Medium Identificational Specifications

Size:	18” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	4” and 2”
Copy and Border Color:	Green
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5E Coin Box - Medium Identificational Schematic



Size:	18” H X 24” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White Reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3”
Copy Color:	Green
Mounting:	Wall mounted (Concrete or Masonry) (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.

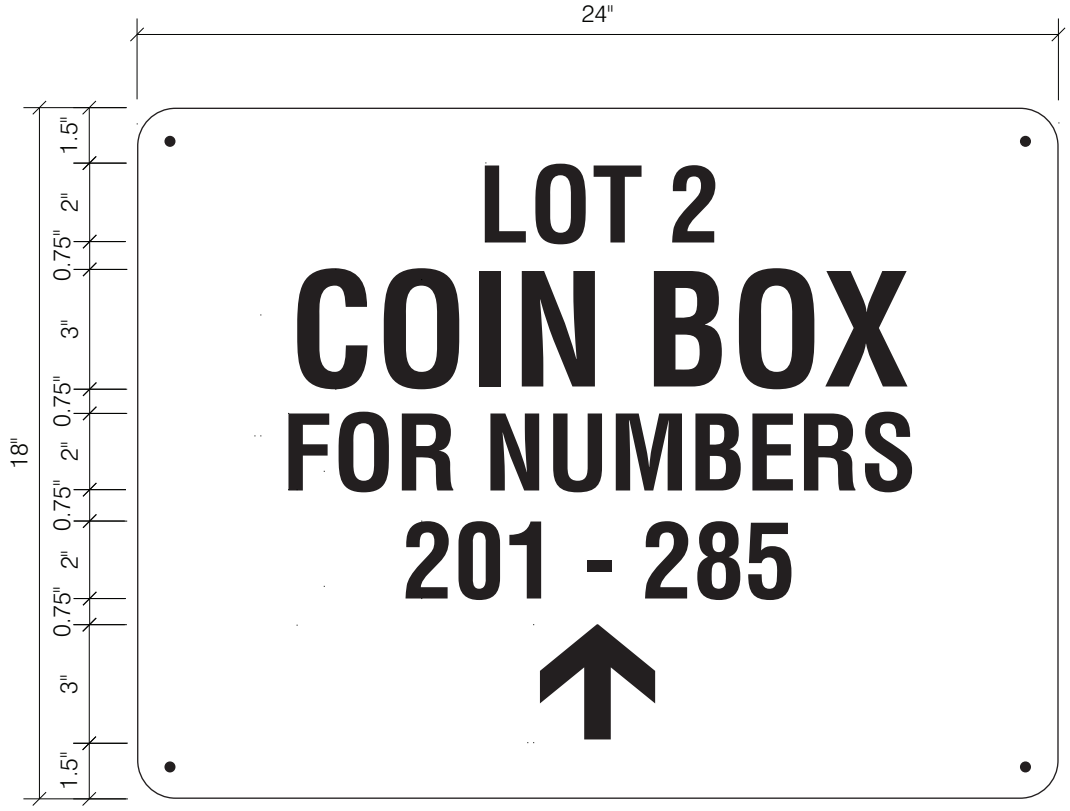
Note: Designer to verify with station location for parking cost.

Size:	18” H X 24” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2” and 3”
Copy Color:	Green
Mounting:	Wall mounted (Concrete or Masonry) (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5G Coin Box - Medium Identificational Schematic

Note: Designer is to verify with station location for parking cost.

Size:	18” H X 24” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2” and 3”
Copy Color:	Green
Arrow Size:	3”
Arrow Color:	Green
Mounting:	Wall Mounted (Concrete or Masonry) (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.


24"
18"
1.5"
2"
0.75"
3"
0.75"
2"
0.75"
2"
0.75"
3"
1.5"
LOT 2
COIN BOX
FOR NUMBERS
201 - 285

Sign Type P-5J Commuter Parking - Large Identificational Specifications

Size:	36” H X 36” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	4”
Copy and Border Color:	Black
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 245 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-5J Commuter Parking - Large Identificational Schematic

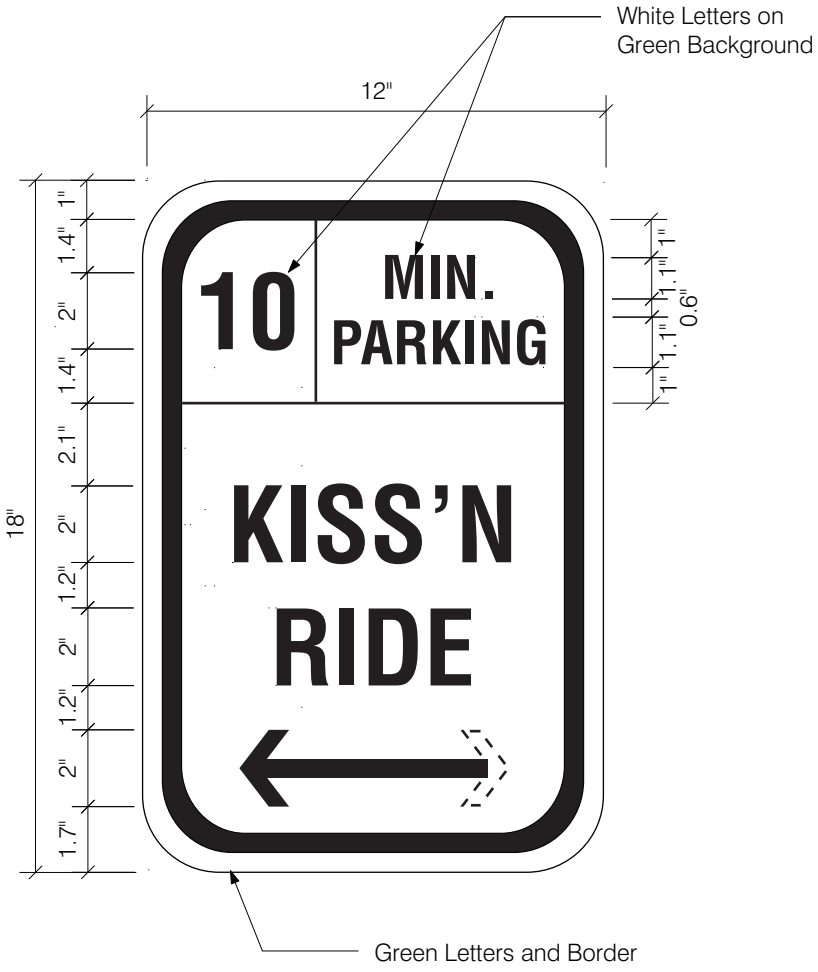
Sign Type P-5K Coin Box - Medium Identificational Specifications

Size:	18” H X 24” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	1.75”, 1.5”, and 1”
Copy Color:	Green
Mounting:	Wall Mounted (Concrete or Masonry) (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

Note: Designer to verify with station location for parking cost.

Sign Type P-6A Kiss 'N Ride - Small Identificational / Directional Specifications

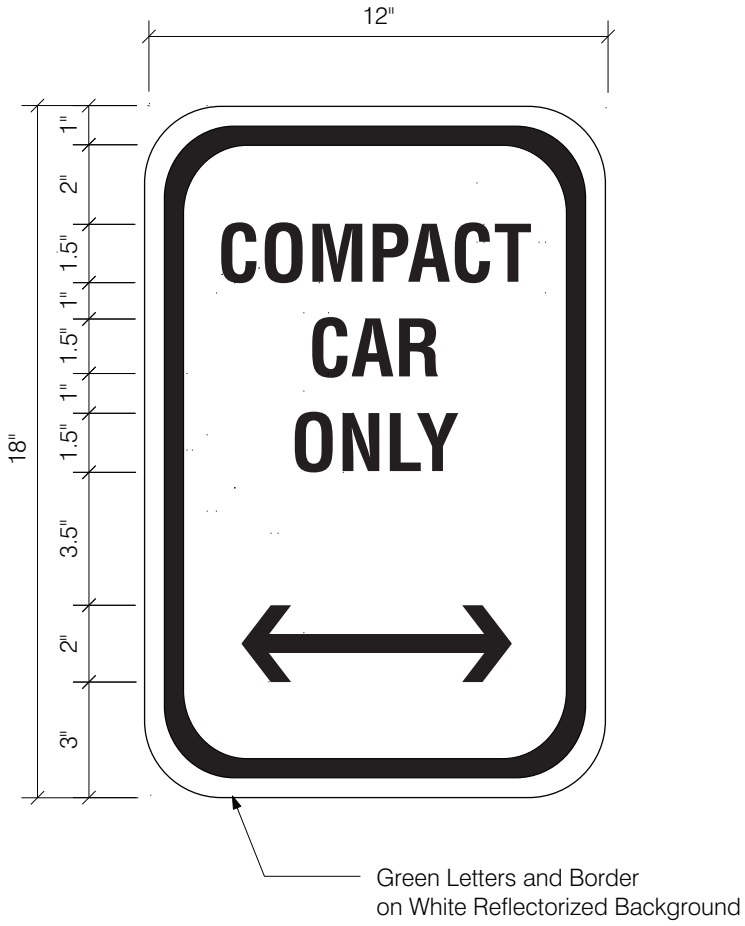
Size:	18" H X 12" W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	1.1" and 2"
Copy and Border Color:	Green
Arrow Size:	2"
Arrow Color:	Green
Mounting:	Post or project mounted (Mounting height 84" from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)


White Letters on
Green Background
12"
18"
1"
1.4"
2"
1.4"
2.1"
2"
1.2"
2"
1.2"
2"
1.7"
10
MIN.
PARKING
KISS'N
RIDE
1"
1.1"
1.1"
0.6"
1"
Green Letters and Border

Sign Type P-6B Compact Car Only - Small Identificational / Directional Specifications

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	1.5”
Copy and Border Color:	Green
Arrow Size:	2”
Arrow Color	Green
Mounting:	Post or project mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

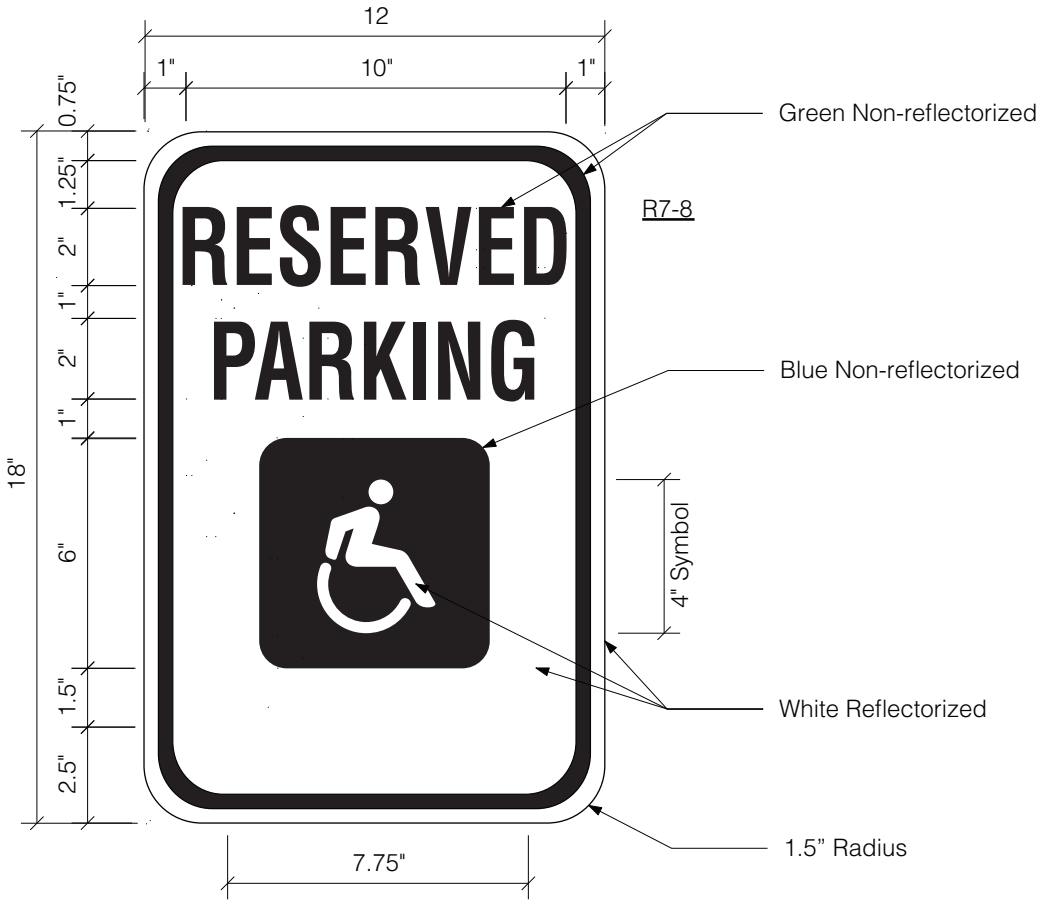
Sign Type P-6B Compact Car Only - Small Identificational / Directional Schematic

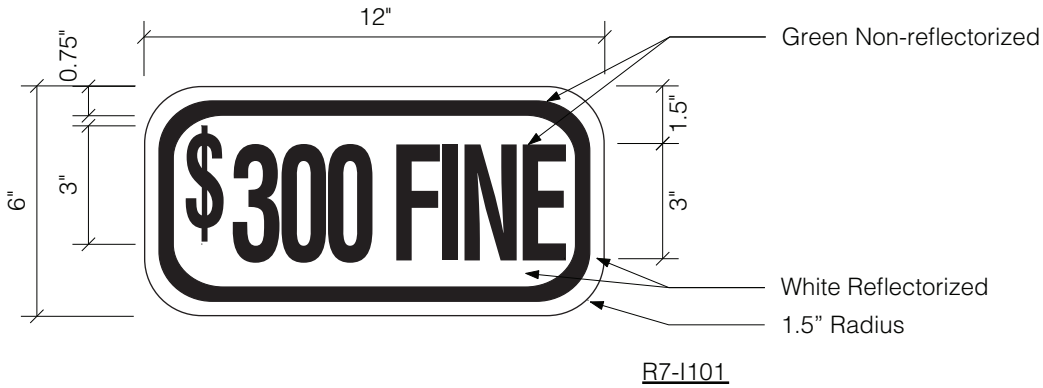


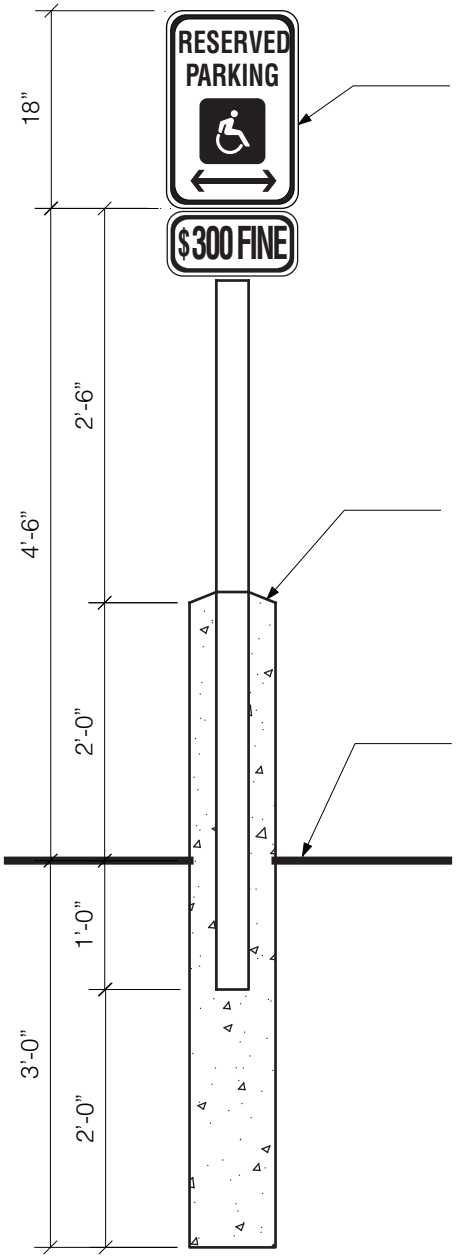
Sign Type P-7A Reserved Parking - Small Identificational (R7-8 & R7-I101) Specifications

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White Reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2”
Copy and Border Color:	Green
Arrow Size:	2” x 7.75”
Arrow Color:	Green
Symbol Size:	6” x 6”
Symbol Color:	White on Blue Background
Mounting:	Post mounted (Mounting height 54” from grade to bottom of sign R7-8) (Fabricator to submit proposed specifications for hardware to Metra for approval.)

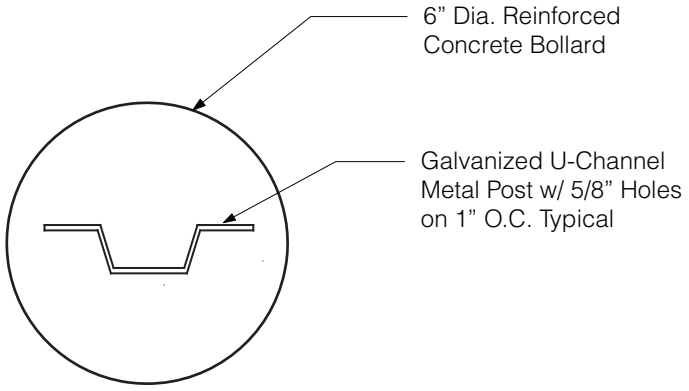
Note: Designer to verify with station location for reserved parking fines.







Parking Sign Detail



Bollard Detail

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	1.5” and 1”
Copy Color:	Green
Symbol Size:	3.75” x 3.75”
Symbol Color:	White Reflective on Green Background
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)


12"
0.75"
3.75"
7.5"
0.75"
3.75"
1.5"
18"
1"
Parking
For
Metra
Patrons Only.
Locks & Items
Left Overnight
Will Be
Removed
& Discarded.

Sign Type P-8B Parking - Small Directional Specifications

Size:	18” H X 12” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	2.5”
Copy Color:	Green
Arrow Size:	2”
Arrow Color:	Green
Symbol Size:	5”
Symbol Color:	Green
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type P-8B Parking - Small Directional Schematic

Description:

In addition to Sign Type 1 - 10, Downtown Terminal Signs, and Parking Signages, specification are provided for Miscellaneous signs that are needed irregularly throughout the system.

Following are general specifications for these sign types as well as schematics showing sign sizes, messages, and placement.

Sign Types:

M-1 Construction Announcement in English or Spanish

M-2 Track Changes

M-3 Metra Construction Sign

M-4 No Skateboarding Biking or Rollerblading

M-5 Station Hours

M-6 Waiting Room Hours

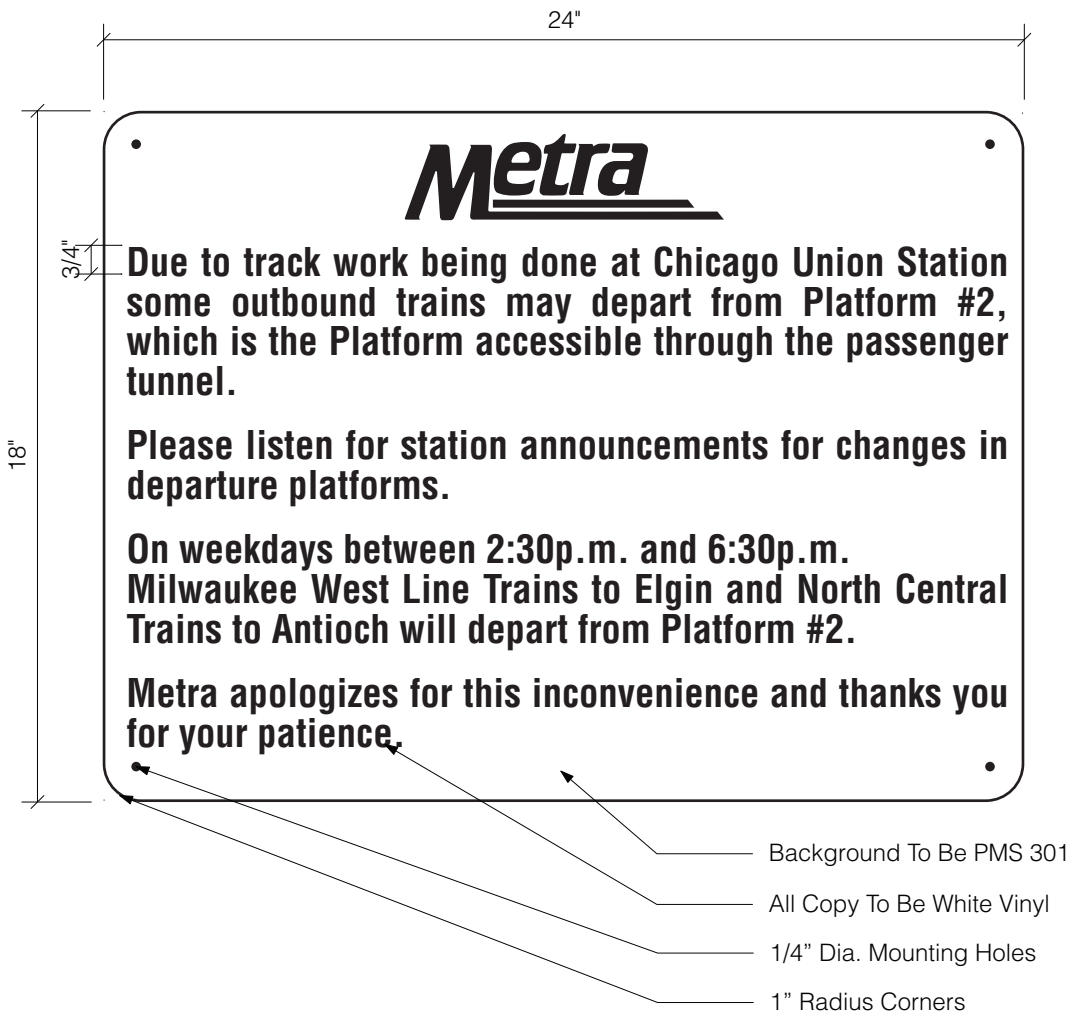
M-7 Ticket Agency Hours

M-8 Plaques

M-9 Plaques

Sign Type M-1 Construction Announcement in English or Spanish Specifications

Size:	18” H X 24” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	0.75” Cap height
Copy Color:	White
Mounting:	Flush Mouted to brick w/ 1/4” dia. x 2” long S.S. tamperproof spanners. Sign to have (4) 1/4” diameter mounting holes.



Metra

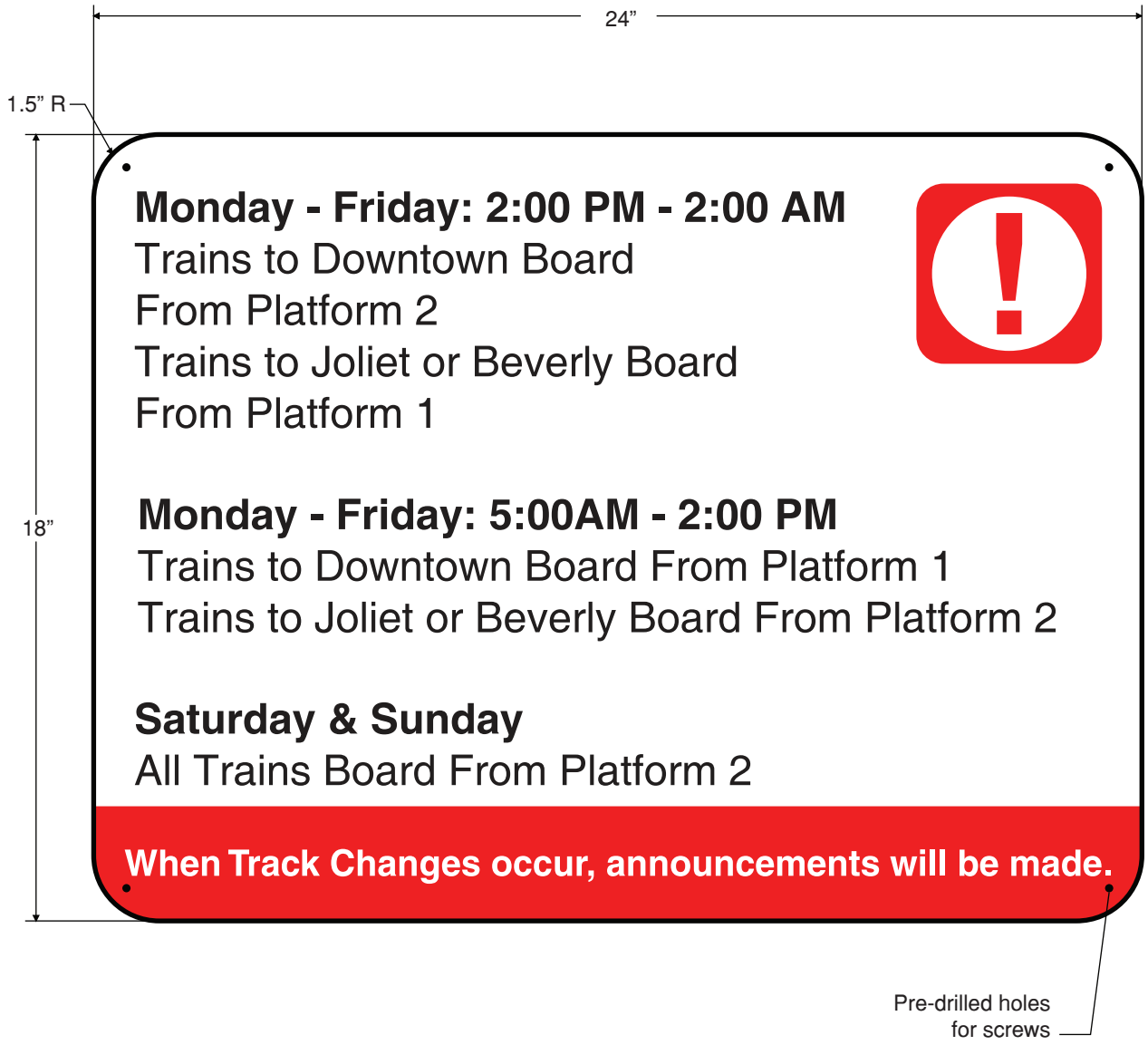
Debido a las reparaciones de las vias ferroviarias alrededor de Chicago Union Station, el Milwaukee West Line que va a Elgin, y el North Central Service que va a Antioch, usaran la plataforma #2 de Lunes a Vierness, durante las horas de 2:30 p.m. a 6:30 p.m. Easta plataforma es accesible a traves del tunel de pasajeros.

Por favor disculpe esta inconvenience, nosotros sinceramente agrademos su paciencia.

Sign Type M-2 Track Changes
Specifications

Size:	18” H X 24” W
Material:	.080 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors & graffiti guard Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White & Red
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors and graffitti guard over coating
Letterform:	Helvetica Bold Condensed and Helvetica Medium
Copy Size:	0.75” Cap height
Copy Color:	Black & White
Symbol Color:	Red & White
Mounting:	Flush Mouted to brick w/ 1/4” dia. x 2” long S.S. tamperproof spanners. Sign to have (4) 1/4” diameter mounting holes.

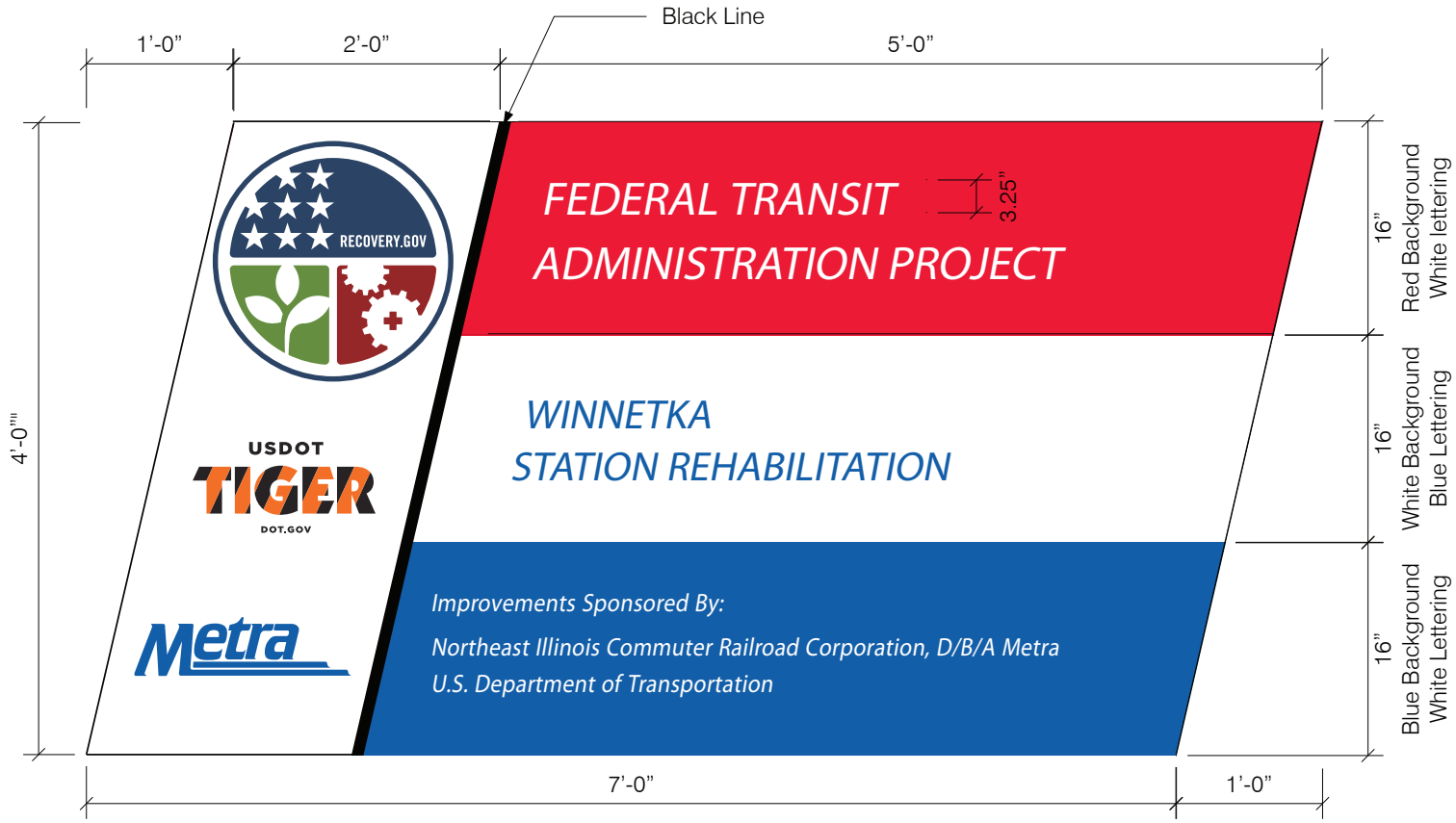
Note: Artwork, copy, and colors may vary, based on station.
Artwork to be supplied by Metra.
Panel may be used in portrait or landscape format.


24”
1.5” R
18”
Monday - Friday: 2:00 PM - 2:00 AM
Trains to Downtown Board
From Platform 2
Trains to Joliet or Beverly Board
From Platform 1
Monday - Friday: 5:00AM - 2:00 PM
Trains to Downtown Board From Platform 1
Trains to Joliet or Beverly Board From Platform 2
Saturday & Sunday
All Trains Board From Platform 2
When Track Changes occur, announcements will be made.
Pre-drilled holes
for screws

Sign Type M-3 Metra Construction Sign Specifications

Size:	48” H X 96” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	Red, Blue, and White
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Futura Bold Italic
Copy Size:	Varies
Copy Color:	White and Blue
Mounting:	Flush Mouted or Post Mounted

Sign Type M-3 Metra Construction Sign Schematic



Metra Construction Sign (Revised 04/09)
Colors: Pantone 1935 Red, Pantone 300 Blue, Black Type: Futura Bold Italic ARRA and Tiger logos available at: www.fta.dot.gov/index_9440_9480.html

Sign Type M-4 No Skateboarding Biking or Roller Blading Specifications

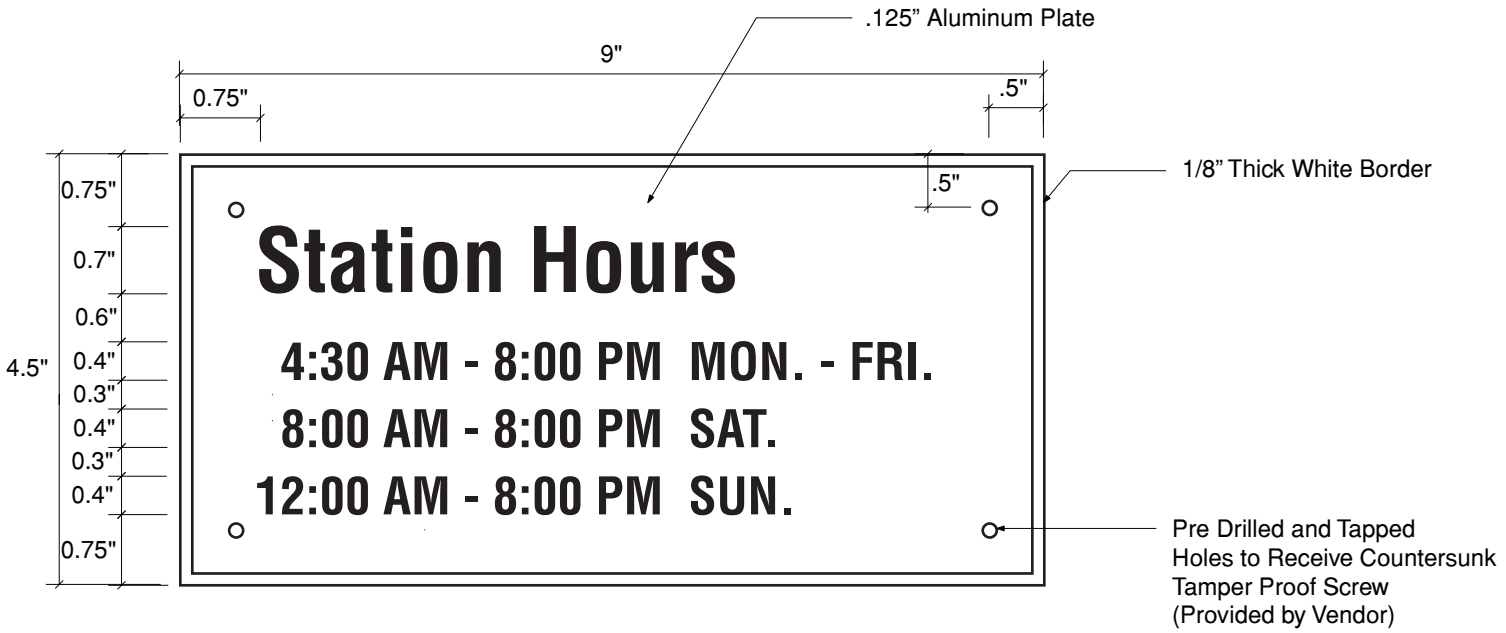
Size:	18” H X 18” W
Material:	.125 Aluminum plate
Finish:	Painted acrylic polyurethane with UV inhibitors Eggshell finish (11-29 degree gloss on 60 degree glossimeter)
Panel Color:	White reflective
Copy:	Silkscreened or vinyl letters with a clear acrylic polyurethane with UV inhibitors over coating
Letterform:	Helvetica Bold Condensed
Copy Size:	3” and 2”
Copy and Border Color:	Green
Mounting:	Post mounted (Mounting height 84” from grade to bottom of sign) See page 253 for detail. (Fabricator to submit proposed specifications for hardware to Metra for approval.)

Sign Type M-4 No Skateboarding Biking or Rollerblading Schematic

Sign Type M-5 Station Hours (4 1/2”H x 9”W)
Specifications

Panel Size:	4 1/2” H x 9” W
Material:	Sign panel to be .125” Aluminum plate.
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Letterform:	Helvetica Bold Condensed
Copy Size:	0.7” and 0.4”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border Color:	White
Mounting:	Flush mounted on walls (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

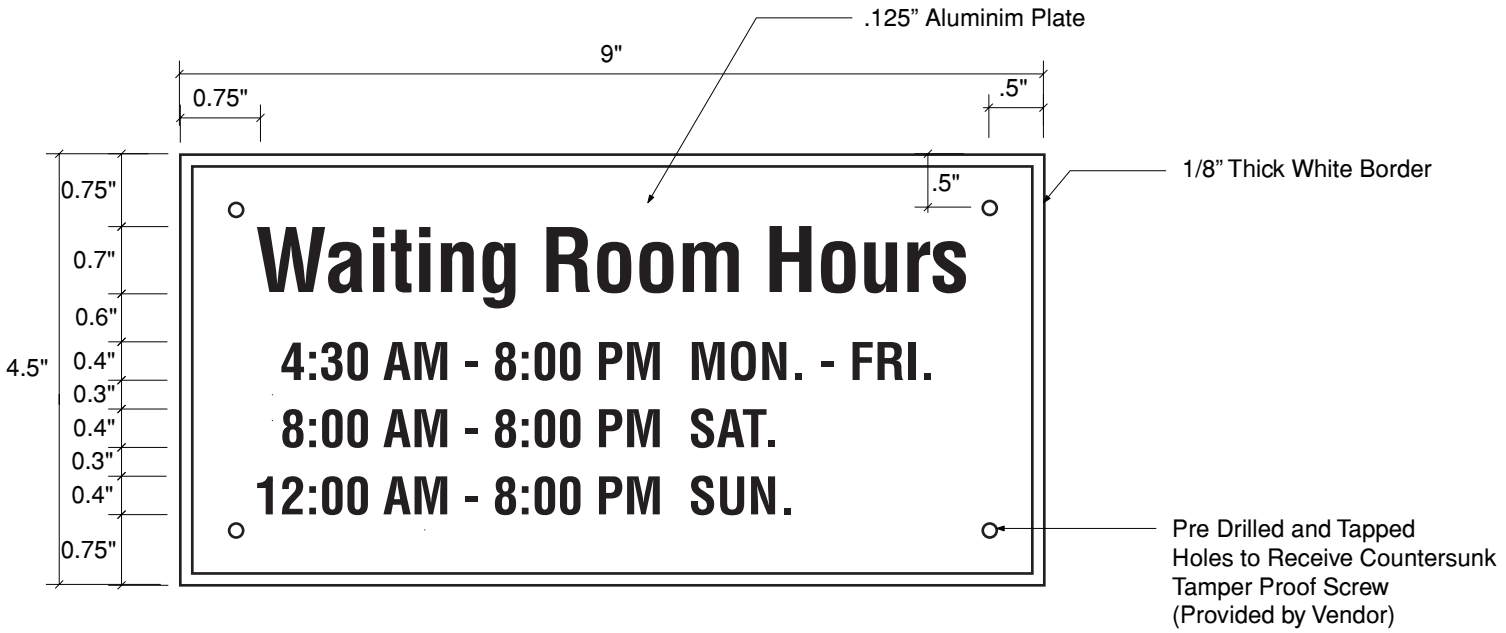
Note: Designer to verify station hours at each location.



Sign Type M-6 Waiting Room Hours (4 1/2”H x 9”W)
Specifications

Panel Size:	4 1/2” H x 9” W
Material:	Sign panel to be .125” thick aluminum panel.
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Letterform:	Helvetica Bold Condensed
Copy Size:	0.7” and 0.4”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border Color:	White
Mounting:	Flush mounted on walls (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

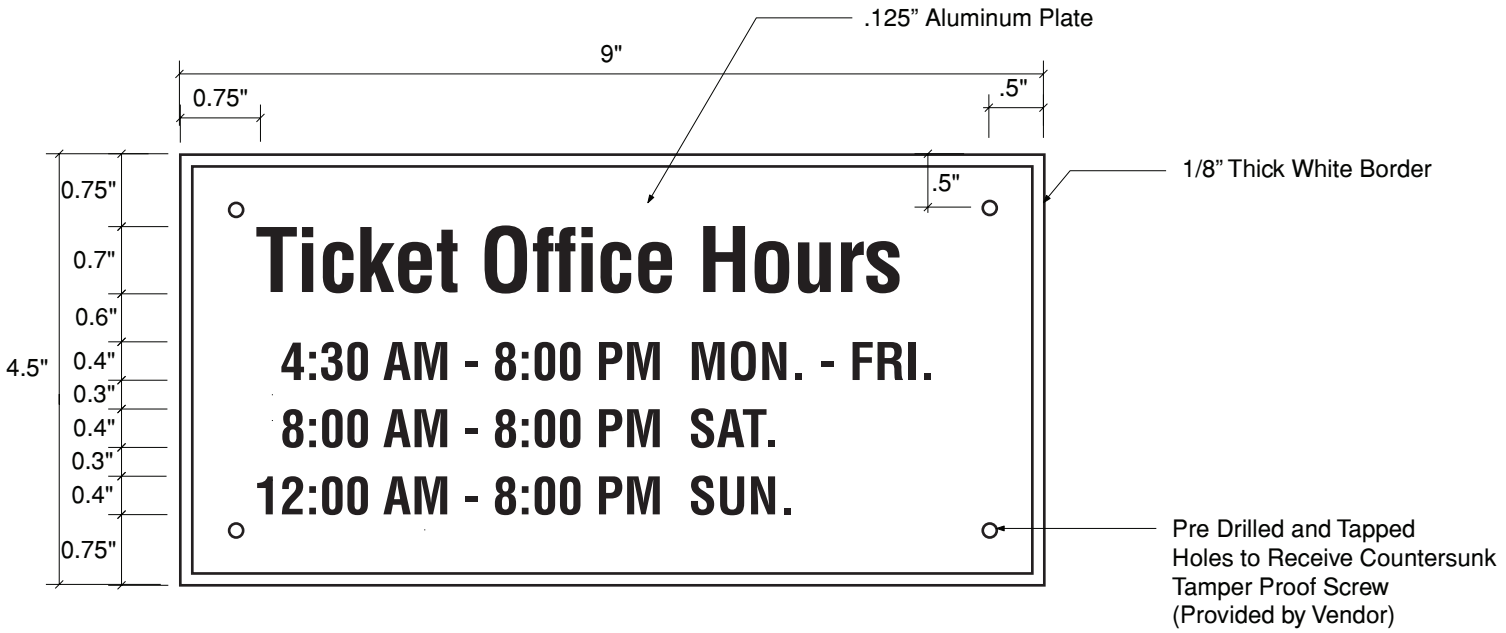
Note: Designer to verify station hours at each location.



Sign Type M-7 Ticket Office Hours (4 1/2”H x 9”W)
Specifications

Panel Size:	4 1/2” H x 9” W
Material:	Sign panel to be .125” thick aluminum plate
Finish:	Eggshell finish (11-19 degree gloss on 60 degree glossimeter)
Panel Color:	To match PMS 301
Letterform:	Helvetica Bold Condensed
Copy Size:	0.7” and 0.4”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border Color:	White
Mounting:	Flush mounted on walls (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

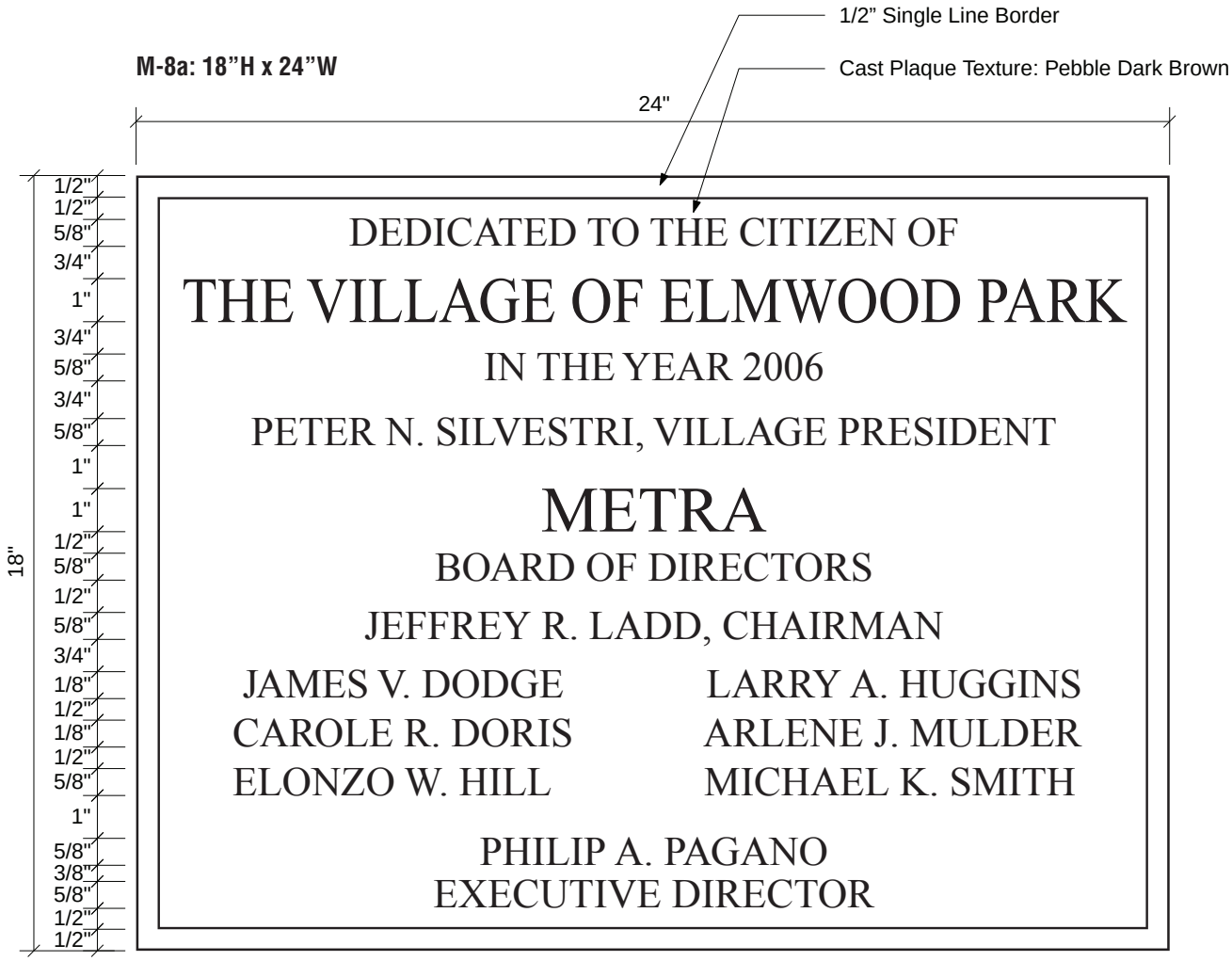
Note: Designer to verify with station hours at each location.



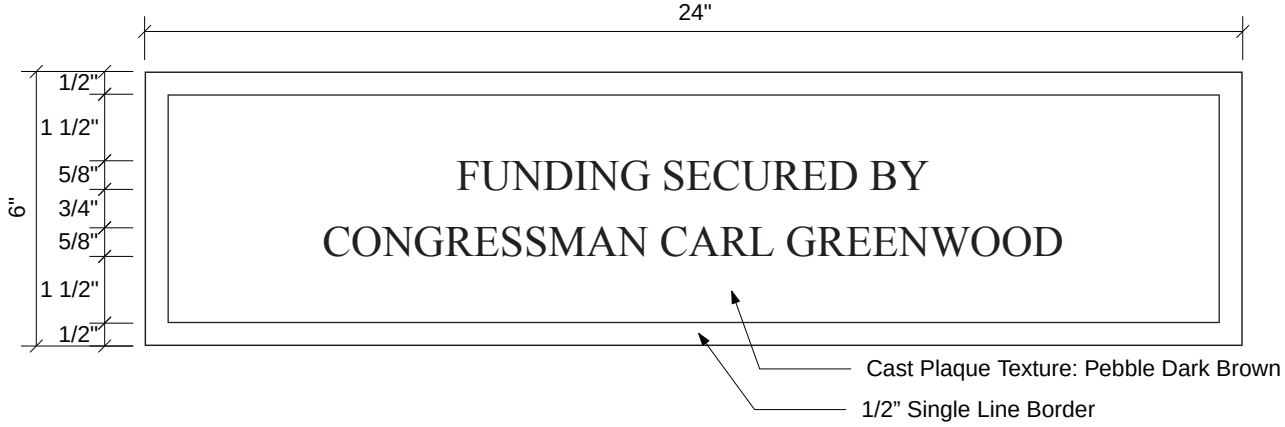
Sign Type M-8 Plaques (18”H x 24”W & 6”H x 24”W) Specifications

Panel Size:	M-8a: 18” H x 24” W M-8b: 6” H x 24” W
Material:	Sign panel to be dark oxidized bronze plate
Finish:	Plaque shall be chemically cleaned and sprayed with two coats of clear acrylic lacquer.
Panel Color:	Dark oxidized
Letterform:	Times (Regular)
Copy Size:	1” and 5/8”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border:	Light polished
Cast Plaque Texture:	Pebble Dark Brown
Mounting:	Blind mount with epoxy adhesive (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)

M-8a: 18”H x 24”W

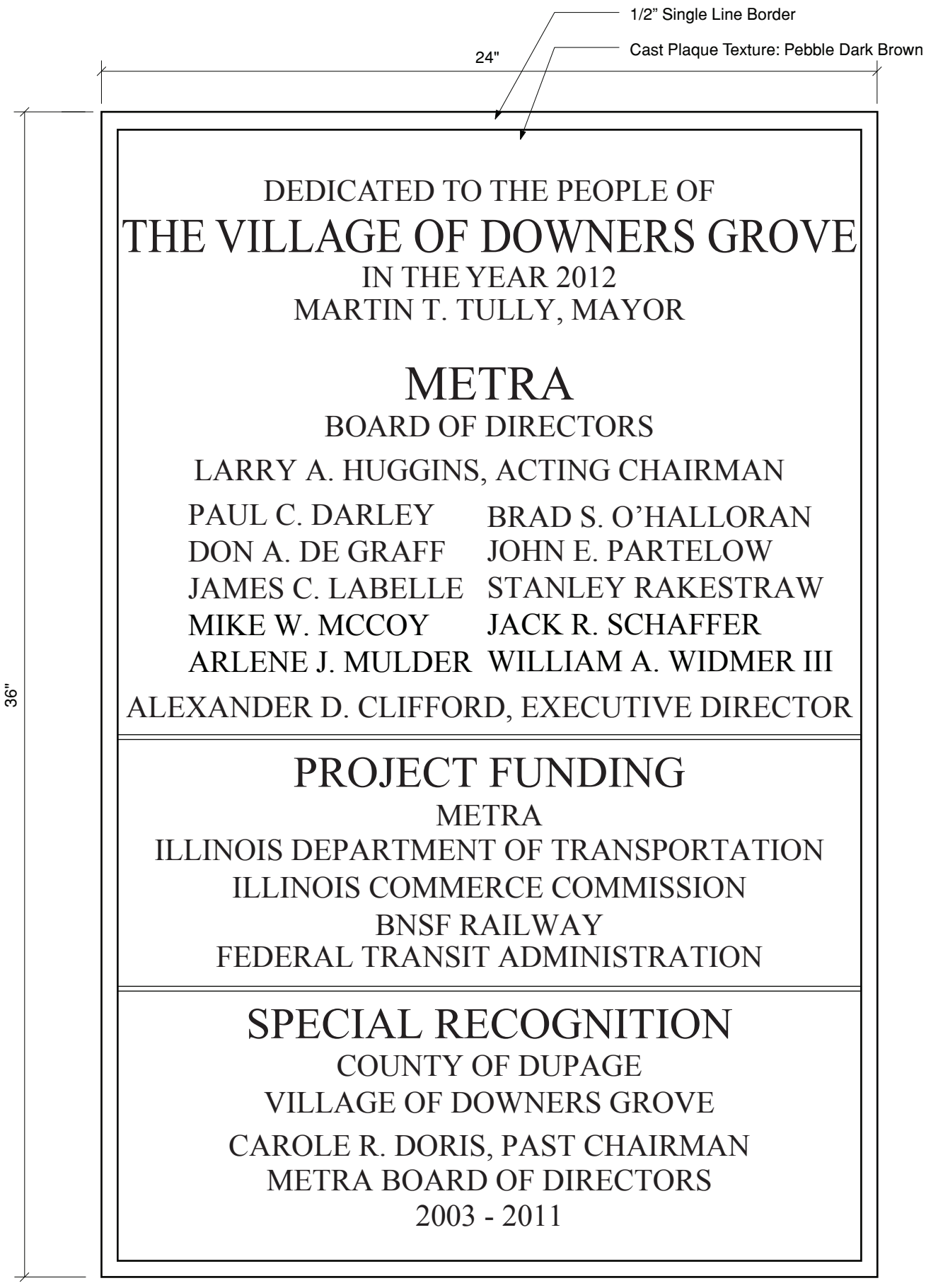


M-8b: 6”H x 24”W



Sign Type M-9 Plaques (36”H x 24”W)
Specifications

Panel Size:	36” H x 24” W
Material:	Sign panel to be dark oxidized bronze plate
Finish:	Plaque shall be chemically cleaned and sprayed with two coats of clear acrylic lacquer.
Panel Color:	Dark oxidized
Letterform:	Times (Regular)
Copy Size:	1” and 5/8”
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy and Border:	Light polished
Cast Plaque Texture:	Pebble Dark Brown
Mounting:	Blind mount with epoxy adhesive (Hardware varies based on existing conditions. Fabricator to submit proposed specifications for hardware to Metra for approval.)



For Design Intent Only

Description:

All hardware, screws, bolts, etc. to be painted black or black anodized, unless on sign face (as in flush mounting an aluminum sign to a wall), in which case they will be painted blue or white to match the panel color.

All hardware is tamper-proof, vandal-resistant and rust-proof.

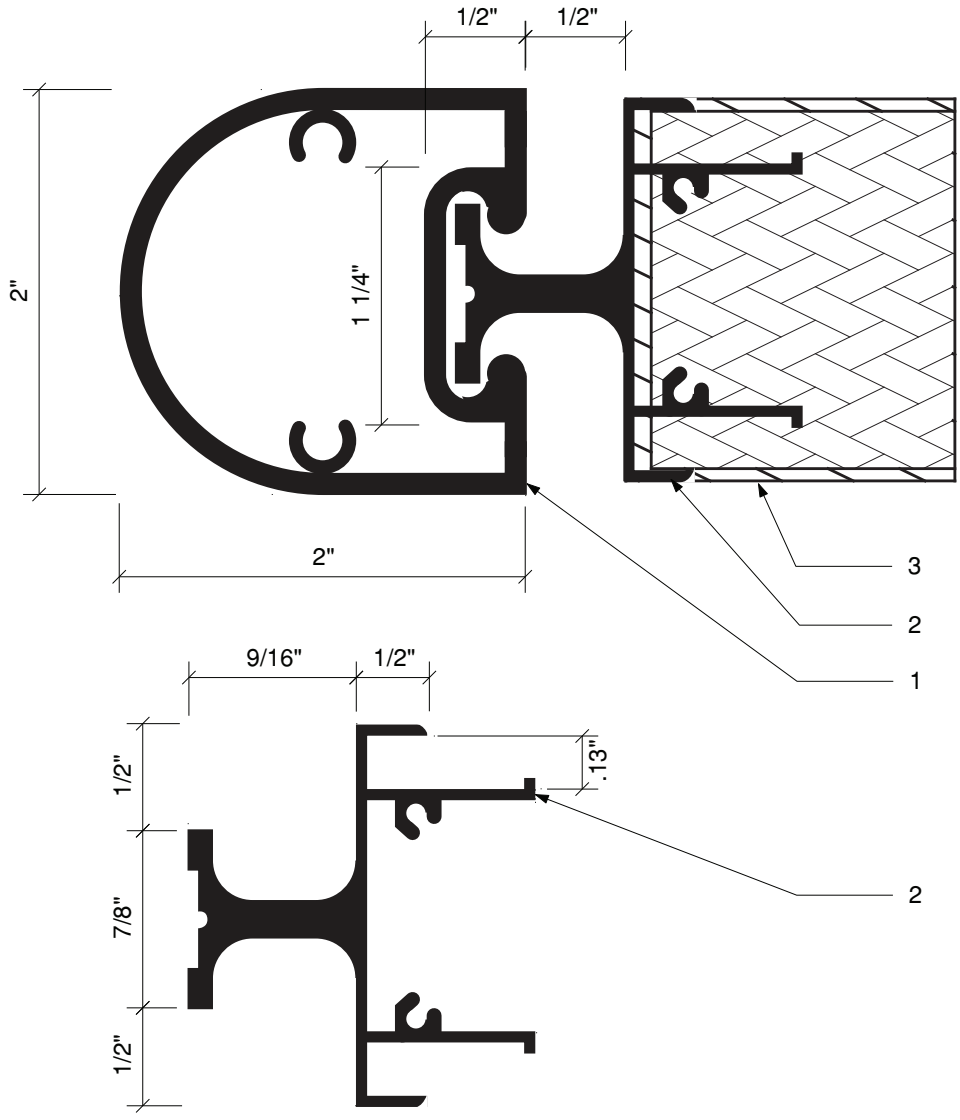
Post-mounted signs may need additional support in posts depending on location.

For All Post Mounted Signs

1. Series 225 Extended Radius Post by Charleston Industries or approved equal in accordance with the following salient characteristics:
   - 0.125 mm Aluminum Extrusion
   - Black Anodized Finish
   - Available in lengths ranging from 6' to 12'
   - Interchangeable with the Existing Charleston Industries 224 frame and 225 post components throughout the Metra System. See dimensions below.

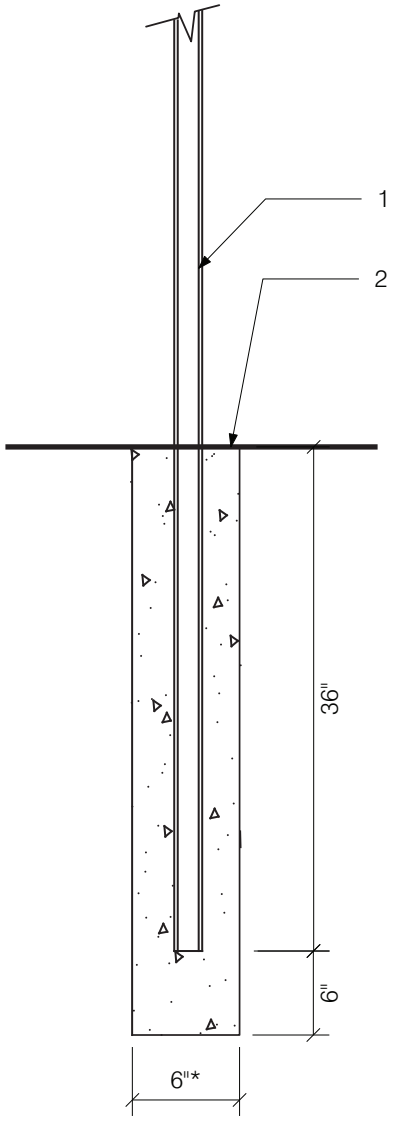
2. Series 224 Standard Side Frame by Charleston Industries or approved equal in accordance with the following salient characteristics:
   - 0.080 mm Aluminum Extrusion
   - Black Anodized Finish
   - Interchangeable with the Existing Charleston Industries 224 frame and 225 post components throughout the Metra System. See dimensions below.

3. Sign (Type 2, 3 or 4)

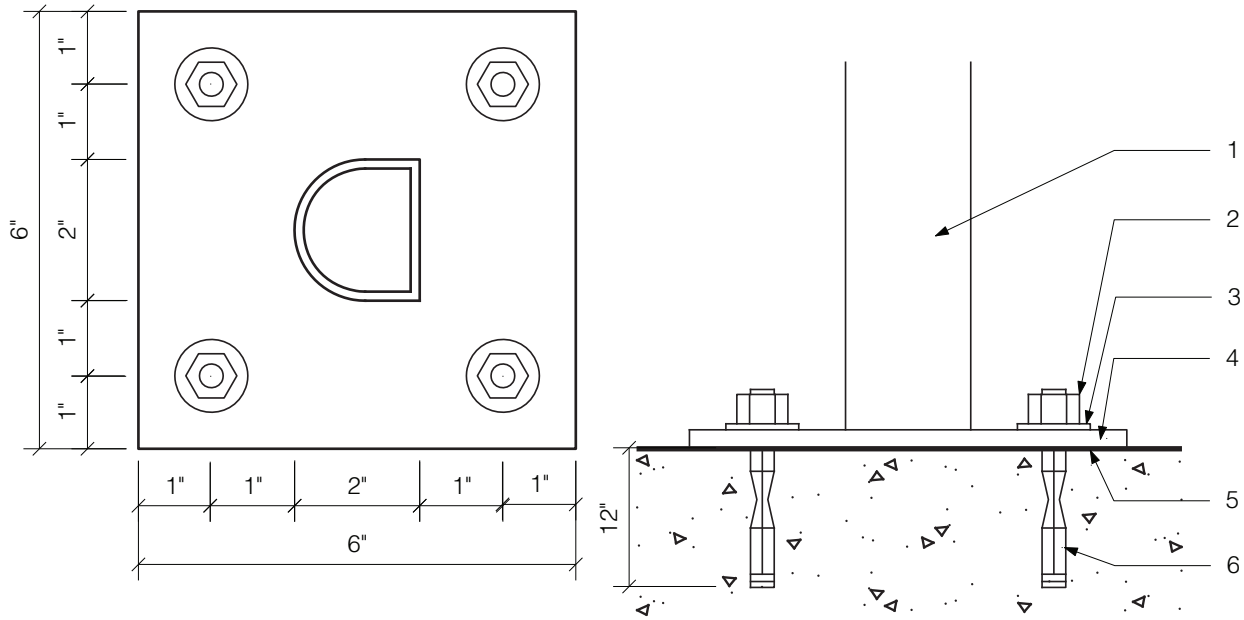


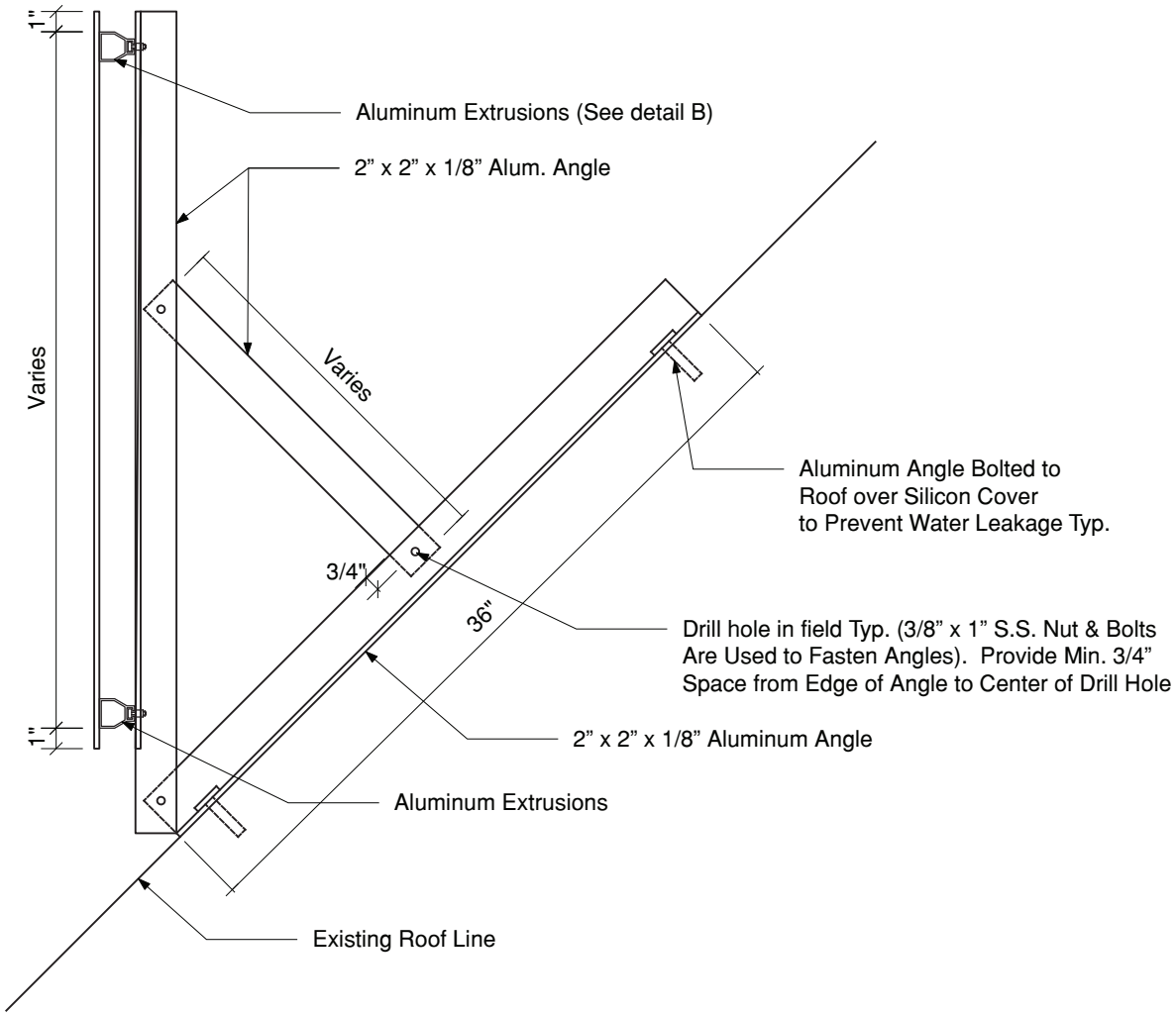
For All Post Mounted Signs
1. 2” x 2” Extruded Aluminum Post
2. Poured Concrete Footing (42” minimum depth)

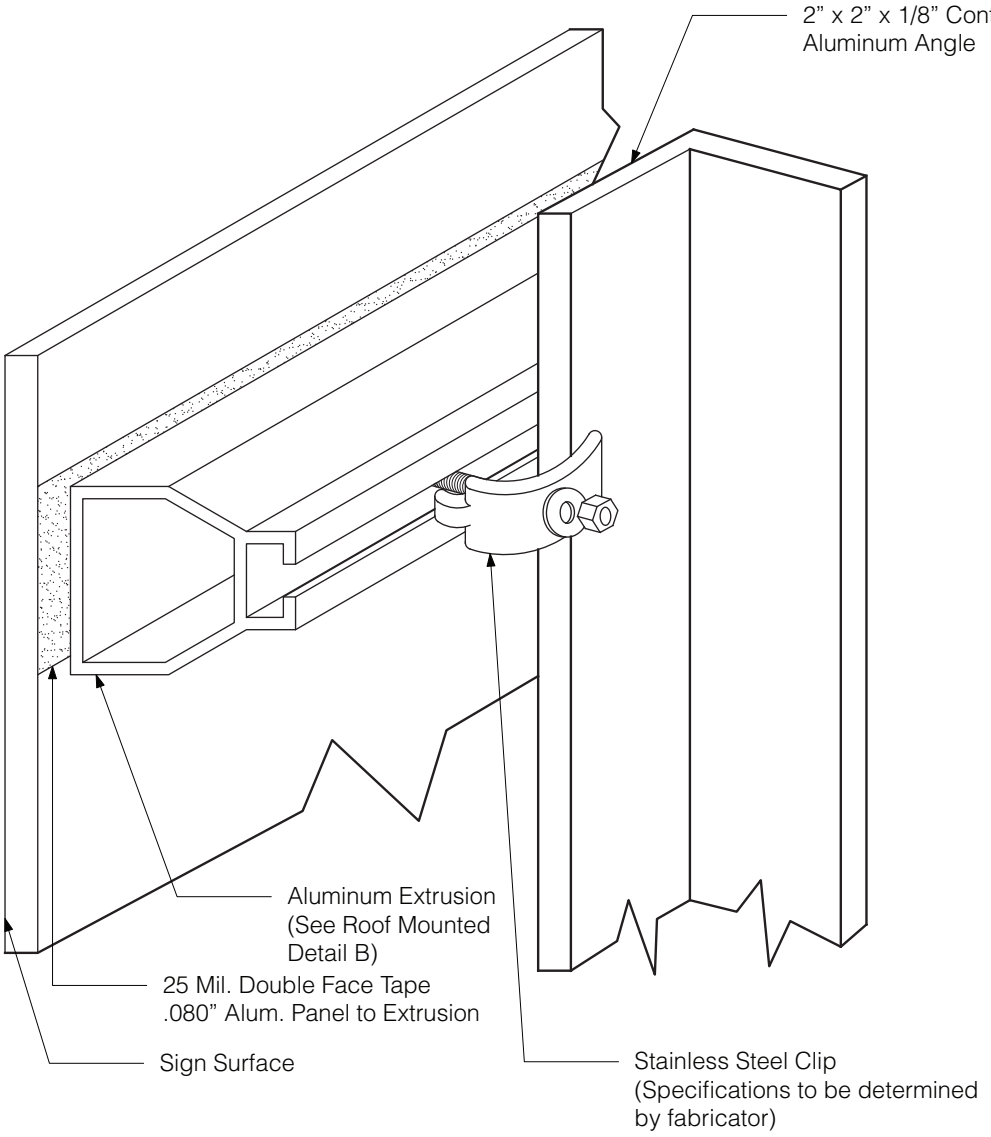
* Please note: Width of Concrete to be Determined by The Contractor and Approved by Metra.



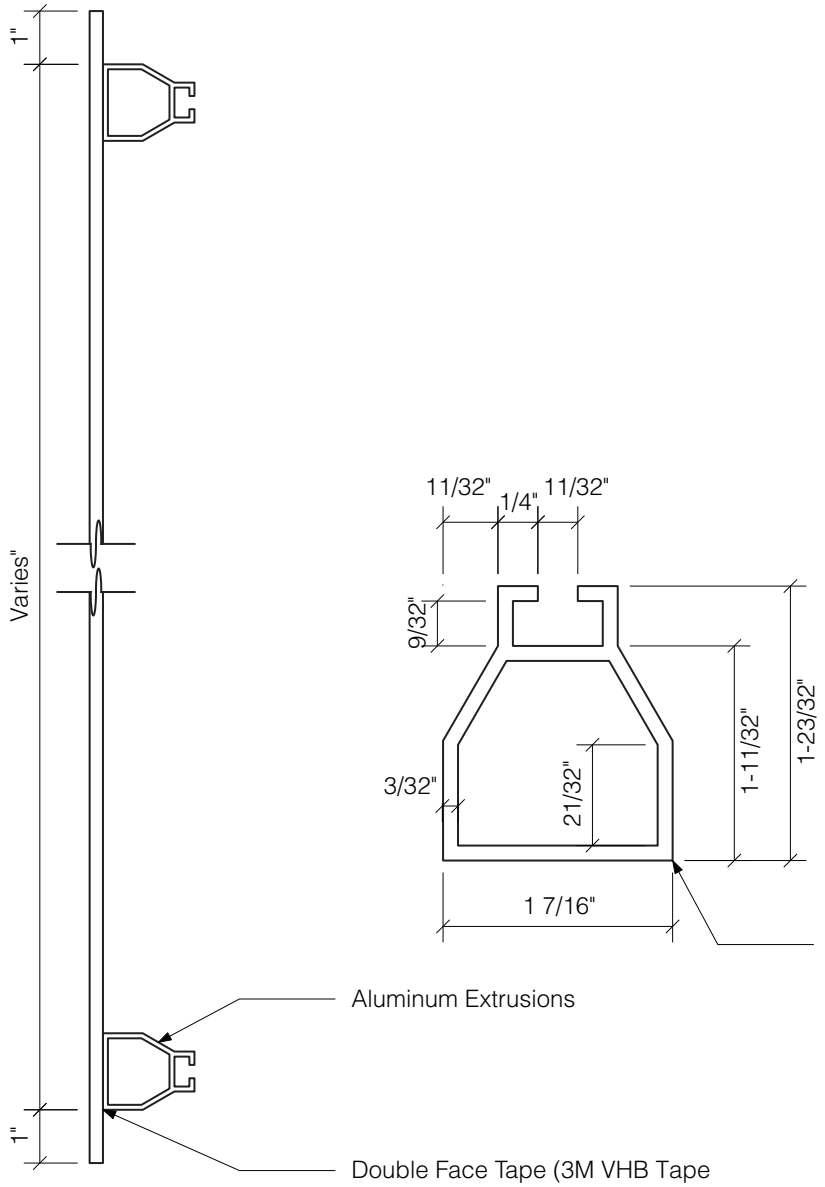
For All Post Mounted Signs
1. 2” x 2” Extruded Aluminum Post Welded on Base Plate
2. Nut
3. Lock Washer
4. .250” Base Plate
5. Top of Existing Concrete Slab or Retaining Wall
6. Retaining Wall use 12” Minimum “J” Bolts / Concrete Slab use Expanding Anchor Bolts




1"
Aluminum Extrusions (See detail B)
2" x 2" x 1/8" Alum. Angle
Varies
Varies
Aluminum Angle Bolted to
Roof over Silicon Cover
to Prevent Water Leakage Typ.
3/4"
36"
Drill hole in field Typ. (3/8" x 1" S.S. Nut & Bolts
Are Used to Fasten Angles). Provide Min. 3/4"
Space from Edge of Angle to Center of Drill Hole
2" x 2" x 1/8" Aluminum Angle
1"
Aluminum Extrusions
Existing Roof Line


2” x 2” x 1/8” Continuous
Aluminum Angle
Aluminum Extrusion
(See Roof Mounted
Detail B)
25 Mil. Double Face Tape
.080” Alum. Panel to Extrusion
Sign Surface
Stainless Steel Clip
(Specifications to be determined
by fabricator)

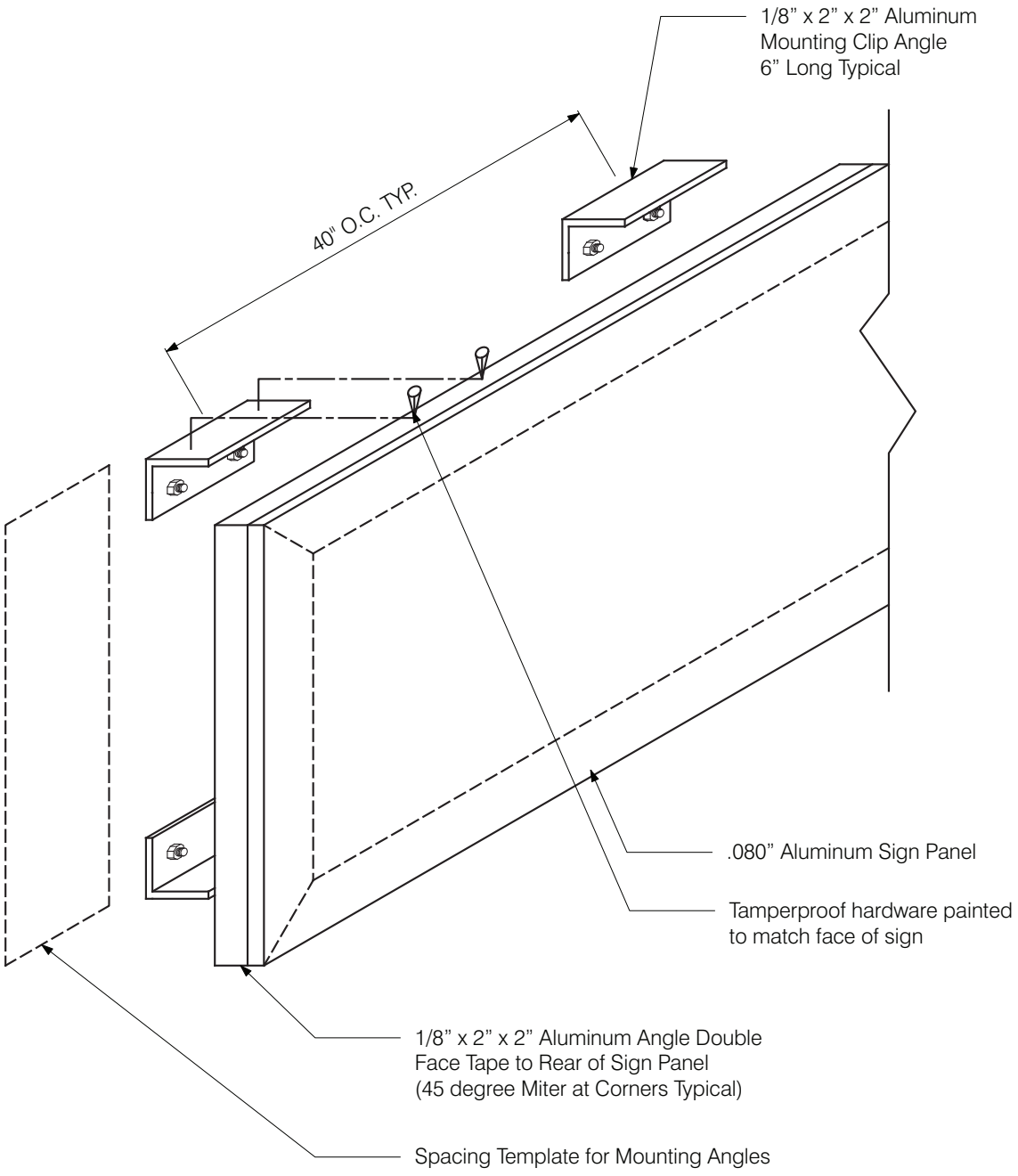
Sign Type 1 - Roof Mounted Detail B
Schematics



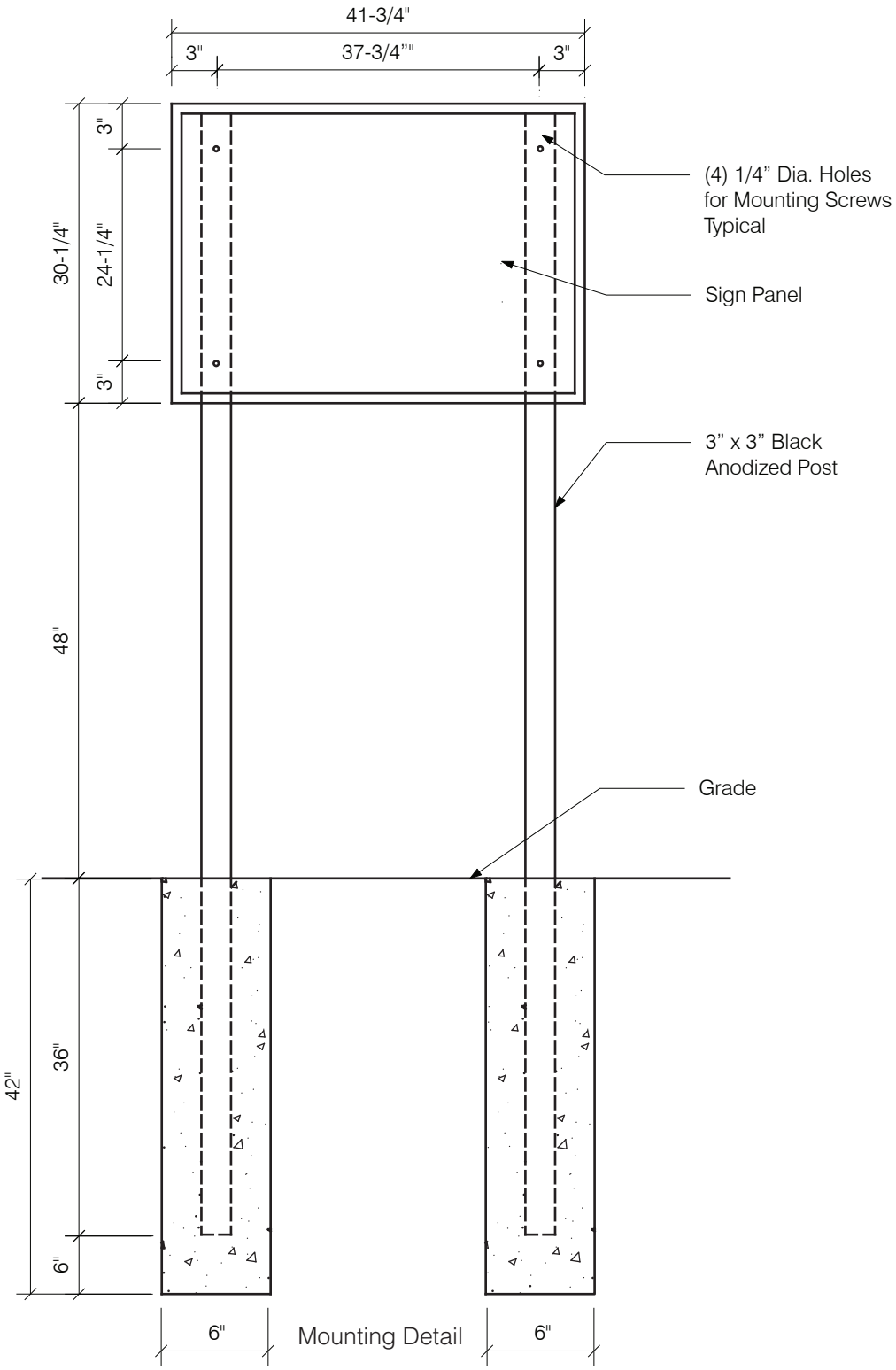
Aluminum Extrusions

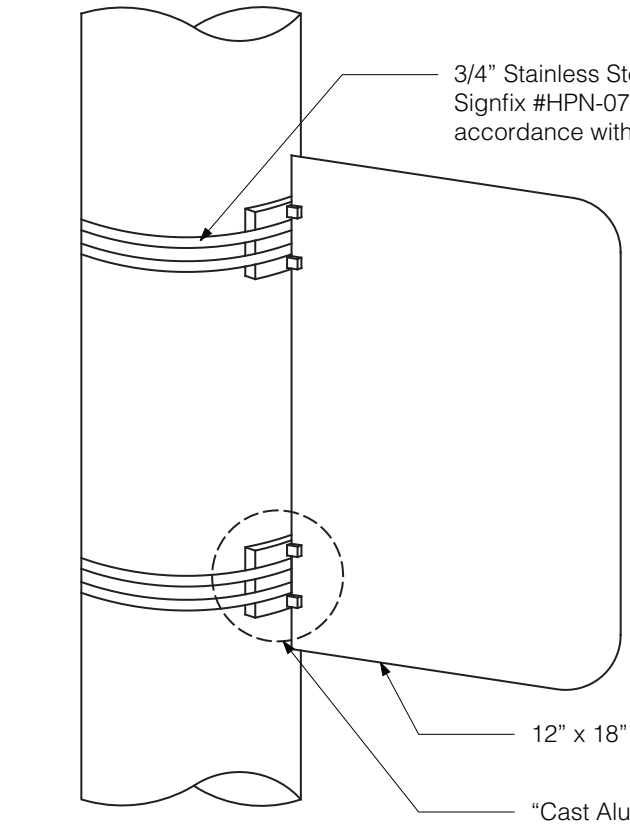
Double Face Tape (3M VHB Tape or approved equal in accordance with the following salient characteristics:
- Construction grade
- High temperature range, and outdoor rated
- Permanent bonding
- Meets ASTM D150, D140 and D257.

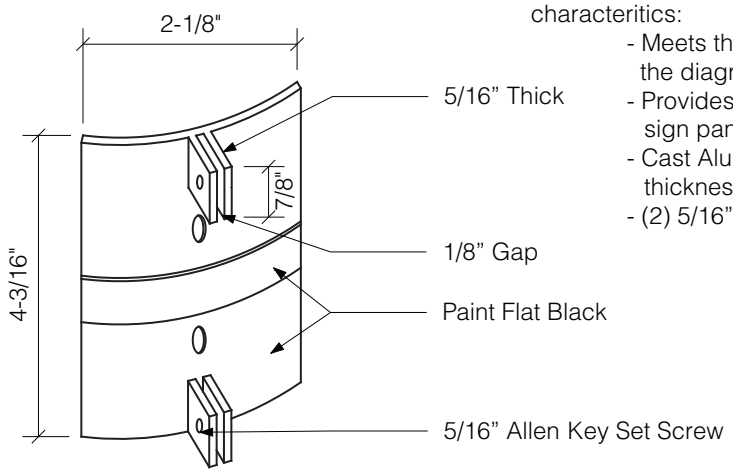
"HB" Aluminum Extrusion "Sign Fix" #HPN-055, or approved equal in accordance with the following salient characteristics:
- Molded channels shall accept stainless steel clamps, which fasten the sign to the post
- Meets AASHTO standard specifications for highway signs & traffic signs



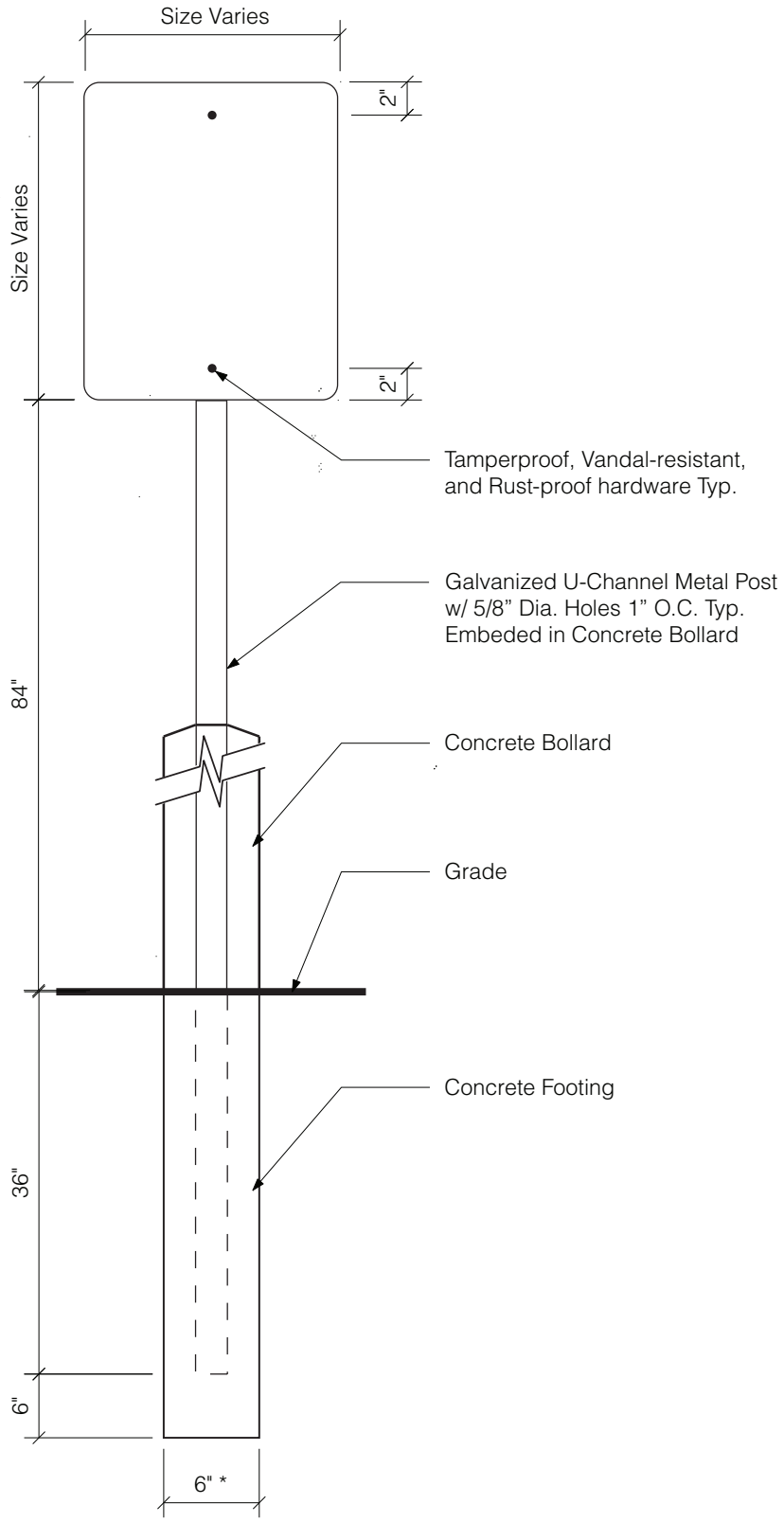
Sign Type 1-Concrete or Wood Wall Mount


41-3/4"
3"
37-3/4""
3"
3"
30-1/4"
24-1/4"
3"
(4) 1/4" Dia. Holes
for Mounting Screws
Typical
Sign Panel
3" x 3" Black
Anodized Post
48"
Grade
42"
36"
6"
6"
Mounting Detail
6"





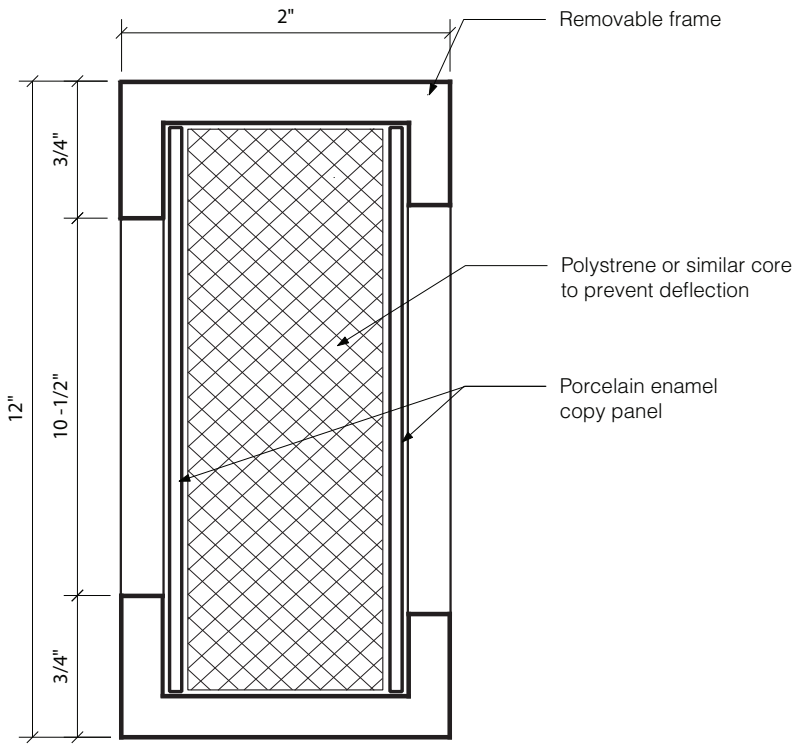
Detail of #4 Wing Bracket



* Please note: Width of Concrete to be Determined by The Contractor and Approved by Metra.

Vandal Resistant Sign - Type 2A
Specifications

Panel Size:	12”H X 72”W
Frame Material:	Sign Panel to be 2” thick, constructed of materials that are vandal-resistant, and scratch, fade and weather resistant.
Frame Finish:	Painted acrylic polyurethane w/ UV inhibitors, Eggshell finish (11-19) degree gloss on 60 degree glossimeter). 1” reflective tape on back of sign - 1 1/2” from bottom edge or Metra logo
Frame Panel Color:	To match PMS 301
Copy Panel:	Porcelain Enamel Copy Panel (Min. 16 GA Steel with Min. 1/32” thick enamel coating) Background color shall be PMS 301.
Copy Panel Finish:	Matte finish
Copy Panel Texture:	Smooth
Letterform:	Helvetica Bold Condensed upper lower Case
Copy Size:	4 1/2” Cap height on station name 2 1/2” Cap height on station line
Letter Spacing:	Manual kerning may be needed (provide layouts for approval)
Copy Color:	White
Symbol:	Parallel tip arrow
Symbol Size:	2 1/2” H
Symbol Color:	White
General Notes:	All copy panels shall be fabricated according to Porcelain Enamel Institute’s requirements and specifications. (See page 258 for a detail of panel)


2"
Removable frame
3/4"
Polystrene or similar core
to prevent deflection
12"
10 -1/2"
Porcelain enamel
copy panel
3/4"

BUILDING REMOVAL - CASE IV (NO ASBESTOS) (BDE)

Effective: September 1, 1990
Revised: April 1, 2010

BUILDING REMOVAL: This work shall consist of the removal and disposal of 1 building(s), together with all foundations, retaining walls, and piers, down to a plane 1 ft (300 mm) below the ultimate or existing grade in the area and also all incidental and collateral work necessary to complete the removal of the building(s) in a manner approved by the Engineer. Any holes, such as basements, shall be filled with a suitable granular material. The building(s) are identified as follows:

Bldg. No.	Parcel No.	Location	Description
1		Southwest corner of Prospect and Burlington Avenues	Shelter for train passengers

Discontinuance of Utilities: The Contractor shall arrange for the discontinuance of all utility services and the removal of the metering devices that serve the building(s) according to the respective requirements and regulations of the City, County, or utility companies involved. The Contractor shall disconnect and seal, in an approved manner, all service outlets that serve any building(s) he/she is to remove.

Signs: Immediately upon execution of the contract and prior to the wrecking of any structures, the Contractor shall be required to paint or stencil, in contrasting colors of an oil base paint, on all four sides of each residence and two opposite sides of other structures, the following sign:

PROPERTY ACQUIRED FOR
HIGHWAY CONSTRUCTION
TO BE DEMOLISHED BY THE

VANDALS WILL BE PROSECUTED

The signs shall be positioned in a prominent location on the structure so that they can be easily seen and read and at a sufficient height to prevent defacing. The Contractor shall not paint signs nor start demolition of any building(s) prior to the time that the State becomes the owner of the respective building(s).

Basis of Payment: This work will be paid for at the contract lump sum unit price for BUILDING REMOVAL, numbers as listed above, which price shall be payment in full for complete removal of the buildings and structures, including any necessary backfilling material as specified herein. The lump sum unit price(s) for this work shall represent the cost of demolition. Any salvage value shall be reflected in the contract unit price for this item.

Notifications: The "Demolition/Renovation Notice" form, which can be obtained from the IEPA office, shall be completed and submitted to the address listed below at least ten days prior to commencement of any demolition activity.

Asbestos Demolition/Renovation Coordinator
Illinois Environmental Protection Agency
Division of Air Pollution Control
P. O. Box 19276
Springfield, Illinois 62794-9276
(217)785-1743

Notices shall be updated if there is a change in the starting date or the amount of asbestos changes by more than 20 percent.

Submittals:

A. All submittals and notices shall be made to the Engineer except where otherwise specified herein.

B. Prior to starting work, the Contractor shall submit proof of written notification and compliance with the “Notifications” paragraph.

5053I

COMPENSABLE DELAY COSTS (BDE)

Effective: June 2, 2017
Revised: April 1, 2019

Revise Article 107.40(b) of the Standard Specifications to read:

"(b) Compensation. Compensation will not be allowed for delays, inconveniences, or damages sustained by the Contractor from conflicts with facilities not meeting the above definition; or if a conflict with a utility in an unanticipated location does not cause a shutdown of the work or a documentable reduction in the rate of progress exceeding the limits set herein. The provisions of Article 104.03 notwithstanding, compensation for delays caused by a utility in an unanticipated location will be paid according to the provisions of this Article governing minor and major delays or reduced rate of production which are defined as follows.

(1) Minor Delay. A minor delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two hours, but not to exceed two weeks.

(2) Major Delay. A major delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two weeks.

(3) Reduced Rate of Production Delay. A reduced rate of production delay occurs when the rate of production on the work in conflict with the utility in an unanticipated location decreases by more than 25 percent and lasts longer than seven calendar days."

Revise Article 107.40(c) of the Standard Specifications to read:

"(c) Payment. Payment for Minor, Major, and Reduced Rate of Production Delays will be made as follows.

(1) Minor Delay. Labor idled which cannot be used on other work will be paid for according to Article 109.04(b)(1) and (2) for the time between start of the delay and the minimum remaining hours in the work shift required by the prevailing practice in the area.

Equipment idled which cannot be used on other work, and which is authorized to standby on the project site by the Engineer, will be paid for according to Article 109.04(b)(4).

(2) Major Delay. Labor will be the same as for a minor delay.

Equipment will be the same as for a minor delay, except Contractor-owned equipment will be limited to two weeks plus the cost of move-out to either the

Contractor's yard or another job and the cost to re-mobilize, whichever is less. Rental equipment may be paid for longer than two weeks provided the Contractor presents adequate support to the Department (including lease agreement) to show retaining equipment on the job is the most economical course to follow and in the public interest.

(3) Reduced Rate of Production Delay. The Contractor will be compensated for the reduced productivity for labor and equipment time in excess of the 25 percent threshold for that portion of the delay in excess of seven calendar days. Determination of compensation will be in accordance with Article 104.02, except labor and material additives will not be permitted.

Payment for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be determined according to Article 109.13."

Revise Article 108.04(b) of the Standard Specifications to read:

"(b) No working day will be charged under the following conditions.

(1) When adverse weather prevents work on the controlling item.

(2) When job conditions due to recent weather prevent work on the controlling item.

(3) When conduct or lack of conduct by the Department or its consultants, representatives, officers, agents, or employees; delay by the Department in making the site available; or delay in furnishing any items required to be furnished to the Contractor by the Department prevents work on the controlling item.

(4) When delays caused by utility or railroad adjustments prevent work on the controlling item.

(5) When strikes, lock-outs, extraordinary delays in transportation, or inability to procure critical materials prevent work on the controlling item, as long as these delays are not due to any fault of the Contractor.

(6) When any condition over which the Contractor has no control prevents work on the controlling item."

Revise Article 109.09(f) of the Standard Specifications to read:

"(f) Basis of Payment. After resolution of a claim in favor of the Contractor, any adjustment in time required for the work will be made according to Section 108. Any adjustment in the costs to be paid will be made for direct labor, direct materials, direct equipment, direct jobsite overhead, direct offsite overhead, and other direct costs allowed by the resolution. Adjustments in costs will not be made for interest charges, loss of anticipated profit, undocumented loss of efficiency, home office overhead and unabsorbed overhead

other than as allowed by Article 109.13, lost opportunity, preparation of claim expenses and other consequential indirect costs regardless of method of calculation.

The above Basis of Payment is an essential element of the contract and the claim cost recovery of the Contractor shall be so limited."

Add the following to Section 109 of the Standard Specifications.

"**109.13 Payment for Contract Delay.** Compensation for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be allowed when such costs result from a delay meeting the criteria in the following table.

Contract Type	Cause of Delay	Length of Delay
Working Days	Article 108.04(b)(3) or Article 108.04(b)(4)	No working days have been charged for two consecutive weeks.
Completion Date	Article 108.08(b)(1) or Article 108.08(b)(7)	The Contractor has been granted a minimum two week extension of contract time, according to Article 108.08.

Payment for each of the various costs will be according to the following.

(a) Escalated Material and/or Labor Costs. When the delay causes work, which would have otherwise been completed, to be done after material and/or labor costs have increased, such increases will be paid. Payment for escalated material costs will be limited to the increased costs substantiated by documentation furnished by the Contractor. Payment for escalated labor costs will be limited to those items in Article 109.04(b)(1) and (2), except the 35 percent and 10 percent additives will not be permitted.

(b) Extended Project Overhead. For the duration of the delay, payment for extended project overhead will be paid as follows.

(1) Direct Jobsite and Offsite Overhead. Payment for documented direct jobsite overhead and documented direct offsite overhead, including onsite supervisory and administrative personnel, will be allowed according to the following table.

Original Contract Amount	Supervisory and Administrative Personnel
Up to $5,000,000	One Project Superintendent
Over $ 5,000,000 - up to $25,000,000	One Project Manager, One Project Superintendent or Engineer, and One Clerk
Over $25,000,000 - up to $50,000,000	One Project Manager, One Project Superintendent, One Engineer, and

	One Clerk
Over $50,000,000	One Project Manager, Two Project Superintendents, One Engineer, and One Clerk

(2) Home Office and Unabsorbed Overhead. Payment for home office and unabsorbed overhead will be calculated as 8 percent of the total delay cost.

(c) Extended Traffic Control. Traffic control required for an extended period of time due to the delay will be paid for according to Article 109.04.

When an extended traffic control adjustment is paid under this provision, an adjusted unit price as provided for in Article 701.20(a) for increase or decrease in the value of work by more than ten percent will not be paid.

Upon payment for a contract delay under this provision, the Contractor shall assign subrogation rights to the Department for the Department's efforts of recovery from any other party for monies paid by the Department as a result of any claim under this provision. The Contractor shall fully cooperate with the Department in its efforts to recover from another party any money paid to the Contractor for delay damages under this provision."

80384

CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)

Effective: June 1, 2010
Revised: November 1, 2014

The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The term "equipment" refers to diesel fuel powered devices rated at 50 hp and above, to be used on the jobsite in excess of seven calendar days over the course of the construction period on the jobsite (including rental equipment).

Contractor and subcontractor diesel powered off-road equipment assigned to the contract shall be retrofitted using the phased in approach shown below. Equipment that is of a model year older than the year given for that equipment's respective horsepower range shall be retrofitted:

Effective Dates	Horsepower Range	Model Year
June 1, 2010 1/	600-749	2002
	750 and up	2006
June 1, 2011 2/	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006
June 1, 2012 2/	50-99	2004
	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006

1/ Effective dates apply to Contractor diesel powered off-road equipment assigned to the contract.

2/ Effective dates apply to Contractor and subcontractor diesel powered off-road equipment assigned to the contract.

The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent and shall be:

a) Included on the U.S. Environmental Protection Agency (USEPA) *Verified Retrofit Technology List* (http://www.epa.gov/cleandiesel/verification/verif-list.htm), or verified by the California Air Resources Board (CARB) (http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm); or

b) Retrofitted with a non-verified diesel retrofit emission control device if verified retrofit emission control devices are not available for equipment proposed to be used on the project, and if the Contractor has obtained a performance certification from the retrofit

device manufacturer that the emission control device provides a minimum PM emission reduction of 50 percent.

Note: Large cranes (Crawler mounted cranes) which are responsible for critical lift operations are exempt from installing retrofit emission control devices if such devices adversely affect equipment operation.

Diesel powered off-road equipment with engine ratings of 50 hp and above, which are unable to be retrofitted with verified emission control devices or if performance certifications are not available which will achieve a minimum 50 percent PM reduction, may be granted a waiver by the Department if documentation is provided showing good faith efforts were made by the Contractor to retrofit the equipment.

Construction shall not proceed until the Contractor submits a certified list of the diesel powered off-road equipment that will be used, and as necessary, retrofitted with emission control devices. The list(s) shall include (1) the equipment number, type, make, Contractor/rental company name; and (2) the emission control devices make, model, USEPA or CARB verification number, or performance certification from the retrofit device manufacturer. Equipment reported as fitted with emissions control devices shall be made available to the Engineer for visual inspection of the device installation, prior to being used on the jobsite.

The Contractor shall submit an updated list of retrofitted off-road construction equipment as retrofitted equipment changes or comes on to the jobsite. The addition or deletion of any diesel powered equipment shall be included on the updated list.

If any diesel powered off-road equipment is found to be in non-compliance with any portion of this special provision, the Engineer will issue the Contractor a diesel retrofit deficiency deduction.

Any costs associated with retrofitting any diesel powered off-road equipment with emission control devices shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed. The Contractor's compliance with this notice and any associated regulations shall not be grounds for a claim.

Diesel Retrofit Deficiency Deduction

When the Engineer determines that a diesel retrofit deficiency exists, a daily monetary deduction will be imposed for each calendar day or fraction thereof the deficiency continues to exist. The calendar day(s) will begin when the time period for correction is exceeded and end with the Engineer's written acceptance of the correction. The daily monetary deduction will be $1,000.00 for each deficiency identified.

The deficiency will be based on lack of diesel retrofit emissions control.

If a Contractor accumulates three diesel retrofit deficiency deductions for the same piece of equipment in a contract period, the Contractor will be shutdown until the deficiency is corrected.

Such a shutdown will not be grounds for any extension of the contract time, waiver of penalties, or be grounds for any claim.

80261

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (BDE)

Effective: September 1, 2000
Revised: March 2, 2019

FEDERAL OBLIGATION. The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR Part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR Part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory.

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department's annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE. The Contractor makes the following assurance and agrees to include the assurance in each subcontract the Contractor signs with a subcontractor.

> The Contractor, subrecipient, or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:
>
> (a) Withholding progress payments;
>
> (b) Assessing sanctions;
>
> (c) Liquidated damages; and/or
>
> (d) Disqualifying the Contractor from future bidding as non-responsible.

OVERALL GOAL SET FOR THE DEPARTMENT. As a requirement of compliance with 49 CFR Part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a

good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR. This contract includes a specific DBE utilization goal established by the Department. The goal has been included because the Department has determined the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. The determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates, in the absence of unlawful discrimination and in an arena of fair and open competition, DBE companies can be expected to perform 14.00 % of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set for in this Special Provision:

(a) The bidder documents enough DBE participation has been obtained to meet the goal or,

(b) The bidder documents a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES. Bidders shall consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217) 785-4611, or by visiting the Department's website at:
http://www.idot.illinois.gov/doing-business/certifications/disadvantaged-business-enterprise-certification/il-ucp-directory/index.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement and failure of the bidder to comply will render the bid not responsive.

The bidder shall submit a DBE Utilization Plan (form SBE 2026), and a DBE Participation Statement (form SBE 2025) for each DBE company proposed for the performance of work to achieve the contract goal, with the bid. If the Utilization Plan indicates the contract goal will not be met, documentation of good faith efforts shall also be submitted. The documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor is selected over a DBE for work on the contract. The required forms and documentation must be submitted as a single .pdf file using the "Integrated Contractor Exchange (iCX)" application within the Department's "EBids System".

The Department will not accept a Utilization Plan if it does not meet the bidding procedures set forth herein and the bid will be declared not responsive. In the event the bid is declared not responsive, the Department may elect to cause the forfeiture of the penal sum of the bidder's proposal guaranty and may deny authorization to bid the project if re-advertised for bids.

GOOD FAITH EFFORT PROCEDURES. The contract will not be awarded until the Utilization Plan is approved. All information submitted by the bidder must be complete, accurate and adequately document enough DBE participation has been obtained or document the good faith efforts of the bidder, in the event enough DBE participation has not been obtained, before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan documents sufficient commercially useful DBE work to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR Part 26, Appendix A. This means the bidder must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts the bidder has made. Mere *pro forma* efforts, in other words efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

(a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases and will be considered by the Department.

(1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.

(2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the Contractor might otherwise prefer to perform these work items with its own forces.

(3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.

b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price difference is excessive or unreasonable. In accordance with the above Bidding Procedures, the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract.

(5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.

(7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.

(8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.

(b) If the Department determines the bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided it is otherwise eligible for award. If the Department determines the

bidder has failed to meet the requirements of this Special Provision or that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification will also include a statement of reasons for the adverse determination. If the Utilization Plan is not approved because it is deficient as a technical matter, unless waived by the Department, the bidder will be notified and will be allowed no more than a five calendar day period to cure the deficiency.

(c) The bidder may request administrative reconsideration of an adverse determination by emailing the Department at "DOT.DBE.UP@illinois.gov" within the five calendar days after the receipt of the notification of the determination. The determination shall become final if a request is not made on or before the fifth calendar day. A request may provide additional written documentation or argument concerning the issues raised in the determination statement of reasons, provided the documentation and arguments address efforts made prior to submitting the bid. The request will be reviewed by the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person to consider all issues of documentation and whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR Part 26.55(c) on questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR Part 26.55, the provisions of which govern over the summary contained herein.

(a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.

(b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.

(c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.

(d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contract. Credit will be given for the following:

(1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.

(2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission is receives as a result of the lease arrangement.

(e) DBE as a material supplier:

(1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.

(2) 100 percent goal credit for the cost of materials of supplies obtained from a DBE manufacturer.

(3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a DBE regular dealer or DBE manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal. All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the DBE Participation Commitment Statement.

(a) NO AMENDMENT. No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be emailed to the Department at DOT.DBE.UP@illinois.gov.

(b) CHANGES TO WORK. Any deviation from the DBE condition-of-award or contract plans, specifications, or special provisions must be approved, in writing, by the Department as provided elsewhere in the Contract. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract. Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A or AER 260A, must be signed and submitted. If the commitment of work is in the form of additional tasks assigned to an existing subcontract, a new Request for Approval of Subcontractor will not be required. However, the Contractor must document efforts to assure the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(c) SUBCONTRACT. The Contractor must provide copies of DBE subcontracts to the Department upon request. Subcontractors shall ensure that all lower tier subcontracts or agreements with DBEs to supply labor or materials be performed in accordance with this Special Provision.

(d) ALTERNATIVE WORK METHODS. In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

(1) The replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or

(2) The DBE is aware its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or

(3) The DBE is not capable of performing the replacement work or has declined to perform the work at a reasonable competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) TERMINATION AND REPLACEMENT PROCEDURES. The Contractor shall not terminate or replace a DBE listed on the approved Utilization Plan, or perform with other forces work designated for a listed DBE except as provided in this Special Provision. The Contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the Contractor obtains the Department's written consent as provided in subsection (a) of this part. Unless Department consent is provided for termination of a DBE subcontractor, the Contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the DBE in the Utilization Plan.

As stated above, the Contractor shall not terminate or replace a DBE subcontractor listed in the approved Utilization Plan without prior written consent. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Written consent will be granted only if the Bureau of Small Business Enterprises agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate or replace the DBE firm. Before transmitting to the Bureau of Small Business Enterprises any request to terminate and/or substitute a DBE subcontractor, the Contractor shall give notice in writing to the DBE subcontractor, with a copy to the Bureau, of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor shall give the DBE five days to respond to the Contractor's notice. The DBE so notified shall advise the Bureau and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Bureau should not approve the Contractor's action. If required in a particular case as a matter of public necessity, the Bureau may provide a response period shorter than five days.

For purposes of this paragraph, good cause includes the following circumstances:

(1) The listed DBE subcontractor fails or refuses to execute a written contract;

(2) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Contractor;

(3) The listed DBE subcontractor fails or refuses to meet the Contractor's reasonable, nondiscriminatory bond requirements;

(4) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;

(5) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1200 or applicable state law.

(6) The Contractor has determined the listed DBE subcontractor is not a responsible contractor;

(7) The listed DBE subcontractor voluntarily withdraws from the projects and provides written notice to the Contractor of its withdrawal;

(8) The listed DBE is ineligible to receive DBE credit for the type of work required;

(9) A DBE owner dies or becomes disabled with the result that the listed DBE subcontractor is unable to complete its work on the contract;

(10) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the Contractor can self-perform the work for which the DBE contractor was engaged or so that the Contractor can substitute another DBE or non-DBE contractor after contract award.

When a DBE is terminated or fails to complete its work on the Contract for any reason, the Contractor shall make a good faith effort to find another DBE to substitute for the original DBE to perform at least the same amount of work under the contract as the terminated DBE to the extent needed to meet the established Contract goal. The good faith efforts shall be documented by the Contractor. If the Department requests documentation under this provision, the Contractor shall submit the documentation within seven days, which may be extended for an additional seven days if necessary at the request of the Contractor. The Department will provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

(f) FINAL PAYMENT. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than 30 calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Resident Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the DBE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (h) of this part.

(g) ENFORCEMENT. The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be

made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.

(h) RECONSIDERATION. Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may request administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of "Good Faith Effort Procedures" of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

80029

DISPOSAL FEES (BDE)

Effective: November 1, 2018

Replace Articles 109.04(b)(5) – 109.04(b)(8) of the Standard Specifications with the following:

"(5) Disposal Fees. When the extra work performed includes paying for disposal fees at a clean construction and demolition debris facility, an uncontaminated soil fill operation or a landfill, the Contractor shall receive, as administrative costs, an amount equal to five percent of the first $10,000 and one percent of any amount over $10,000 of the total approved costs of such fees.

(6) Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

(7) Statements. No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with itemized statements of the cost of such force account work. Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from his/her stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

Itemized statements at the cost of force account work shall be detailed as follows.

a. Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman. Payrolls shall be submitted to substantiate actual wages paid if so requested by the Engineer.

b. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.

c. Quantities of materials, prices and extensions.

d. Transportation of materials.

e. Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.

(8) Work Performed by an Approved Subcontractor. When extra work is performed by an approved subcontractor, the Contractor shall receive, as administrative costs, an amount equal to five percent of the total approved costs of such work with the minimum payment being $100.

(9) All statements of the cost of force account work shall be furnished to the Engineer not later than 60 days after receipt of the Central Bureau of Construction form “Extra Work Daily Report”. If the statement is not received within the specified time frame, all demands for payment for the extra work are waived and the Department is released from any and all such demands. It is the responsibility of the Contractor to ensure that all statements are received within the specified time regardless of the manner or method of delivery.”

80402

EMULSIFIED ASPHALTS (BDE)

Effective: August 1, 2019

Revise Article 1032.06 of the Standard Specifications to read:

"**1032.06 Emulsified Asphalts.** Emulsified asphalts will be accepted according to the current Bureau of Materials Policy Memorandum, "Emulsified Asphalt Acceptance Procedure". These materials shall be homogeneous and shall show no separation of asphalt after thorough mixing, within 30 days after delivery, provided separation has not been caused by freezing. They shall coat the aggregate being used in the work to the satisfaction of the Engineer and shall be according to the following requirements.

(a) Anionic Emulsified Asphalt. Anionic emulsified asphalts RS-1, RS-2, HFRS-2, SS-1h, and SS-1 shall be according to AASHTO M 140, except as follows.

(1) The cement mixing test will be waived when the emulsion is being used as a tack coat.

(2) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

(b) Cationic Emulsified Asphalt. Cationic emulsified asphalts CRS-1, CRS-2, CSS-1h, and CSS-1 shall be according to AASHTO M 208, except as follows.

(1) The cement mixing test will be waived when the emulsion is being used as a tack coat.

(2) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

(c) High Float Emulsion. High float emulsions HFE-90, HFE-150, and HFE-300 are medium setting and shall be according to the following table.

Test	HFE-90	HFE-150	HFE-300
Viscosity, Saybolt Furol, at 122 °F (50 °C), (AASHTO T 59), SFS [1/]	50 min.	50 min.	50 min.
Sieve Test, No. 20 (850 µm), retained on sieve, (AASHTO T 59), %	0.10 max.	0.10 max.	0.10 max.
Storage Stability Test, 1 day, (AASHTO T 59), %	1 max.	1 max.	1 max.
Coating Test (All Grades), (AASHTO T 59), 3 minutes	stone coated thoroughly		
Distillation Test, (AASHTO T 59): Residue from distillation test to 500 °F (260 °C), % Oil distillate by volume, %	65 min. 7 max.	65 min. 7 max.	65 min. 7 max.

Characteristics of residue from distillation test to 500 °F (260 °C): Penetration at 77 °F (25 °C), (AASHTO T 49), 100 g, 5 sec, dmm	90-150	150-300	300 min.
Float Test at 140 °F (60 °C), (AASHTO T 50), sec.	1200 min.	1200 min.	1200 min.

1/ The emulsion shall be pumpable.

(d) Penetrating Emulsified Prime. Penetrating Emulsified Prime (PEP) shall be according to AASHTO T 59, except as follows.

Test	Result
Viscosity, Saybolt Furol, at 77 °F (25 °C), SFS	75 max.
Sieve test, retained on No. 20 (850 µm) sieve, %	0.10 max.
Distillation to 500 °F (260 °C) residue, %	38 min.
Oil distillate by volume, %	4 max.

The PEP shall be tested according to the current Bureau of Materials Illinois Laboratory Test Procedure (ILTP), "Sand Penetration Test of Penetrating Emulsified Prime (PEP)". The time of penetration shall be equal to or less than that of MC-30. The depth of penetration shall be equal to or greater than that of MC-30.

(e) Delete this subparagraph.

(f) Polymer Modified Emulsified Asphalt. Polymer modified emulsified asphalts, e.g. SS-1hP, CSS-1hP, CRS-2P (formerly CRSP), CQS-1hP (formerly CSS-1h Latex Modified) and HFRS-2P (formerly HFP) shall be according to AASHTO M 316, except as follows.

(1) The cement mixing test will be waived when the polymer modified emulsion is being used as a tack coat.

(2) CQS-1hP (formerly CSS-1h Latex Modified) emulsion for micro-surfacing treatments shall use latex as the modifier.

(3) Upon examination of the storage stability test cylinder after standing undisturbed for 24 hours, the surface shall show minimal to no white, milky colored substance and shall be a homogenous brown color throughout.

(4) The distillation for all polymer modified emulsions shall be performed according to AASHTO T 59, except the temperature shall be 374 ± 9 °F (190 ± 5 °C) to be held for a period of 15 minutes and measured using an ASTM 16F (16C) thermometer.

(5) The specified temperature for the Elastic Recovery test for all polymer modified emulsions shall be 50.0 ± 1.0 °F (10.0 ± 0.5 °C).

(6) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

(g) Non-Tracking Emulsified Asphalt. Non-tracking emulsified asphalt NTEA (formerly SS-1vh) shall be according to the following.

Test	Requirement
Saybolt Viscosity at 77 °F (25 °C), (AASHTO T 59), SFS	20-100
Storage Stability Test, 24 hr, (AASHTO T 59), %	1 max.
Residue by Distillation, 500 ± 10 °F (260 ± 5 °C), or Residue by Evaporation, 325 ± 5 °F (163 ± 3 °C), (AASHTO T 59), %	50 min.
Sieve Test, No. 20 (850 µm), (AASHTO T 59), %	0.3 max.
Tests on Residue from Evaporation	
Penetration at 77 °F (25 °C), 100 g, 5 sec, (AASHTO T 49), dmm	40 max.
Softening Point, (AASHTO T 53), °F (°C)	135 (57) min.
Ash Content, (AASHTO T 111), % 1/	1 max.

1/ The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent

The different grades are, in general, used for the following.

Grade	Use
SS-1, SS-1h, RS-1, RS-2, CSS-1, CRS-1, CRS-2, CSS-1h, HFE-90, SS-1hP, CSS-1hP, NTEA (formerly SS-1vh)	Tack Coat
PEP	Prime Coat
RS-2, HFE-90, HFE-150, HFE-300, CRS-2P (formerly CRSP), HFRS-2P (formerly HFP), CRS-2, HFRS-2	Bituminous Surface Treatment
CQS-1hP (formerly CSS-1h Latex Modified)	Micro-Surfacing Slurry Sealing Cape Seal”

80415

ENGINEER'S FIELD OFFICE AND LABORATORY (BDE)

Effective: January 1, 2020

Revise the last sentence of the first paragraph of Article 670.01 of the Standard Specifications to read:

"The building shall remain available for use until released by the Engineer."

Revise the fifth and sixth paragraphs of Article 670.02 of the Standard Specifications to read:

"Sanitary facilities shall include hot and cold potable running water, lavatory and toilet as an integral part of the office where available. A portable toilet, if necessary, shall be serviced once per week. Solid waste disposal consisting of two waste baskets and an outside trash container of sufficient size to accommodate a weekly provided pick-up service.

In addition, the following furniture and equipment meeting the approval of the Engineer shall be furnished."

Revise Article 670.02(b) through 670.02(r) of the Standard Specifications to read:

"(b) One desk with minimum working surface of 48 x 72 in. (1.2 x 1.8 m).

(c) Two free standing four drawer legal size file cabinets with lock and an underwriters' laboratories insulated file device 350 degrees one hour rating.

(d) Table(s) and chairs capable of seating 10 people.

(e) One equipment cabinet of minimum inside dimension of 44 in. (1100 mm) high x 24 in. (600 mm) wide x 30 in. (750 mm) deep with lock. The walls shall be of steel with a 3/32 in. (2 mm) minimum thickness with concealed hinges and enclosed lock constructed in such a manner as to prevent entry by force. The cabinet assembly shall be permanently attached to a structural element of the field office in a manner to prevent theft of the entire cabinet.

(f) One refrigerator with a minimum size of 14 cu ft (0.40 cu m) with a freezer unit.

(g) One electric desk type tape printing calculator.

(h) A minimum of two communication paths. The configuration shall include:

(1) Internet Connection. An internet service connection with a wireless router capable of providing service to a minimum of five devices. The internet service shall be for unlimited data with a minimum internet data download speed of 25 megabits per second. For areas where this minimum download speed is not available, the maximum speed available for the area shall be provided.

(2) Telephone Line. One landline touch tone telephone with voicemail or answering machine. The telephone shall have an unpublished number.

(i) One plain paper wireless color printer capable of reproducing prints up to 11 x 17 in. (280 x 432 mm) with an automatic feed tray. Separate paper trays for letter size and 11 x 17 in. (280 x 432 mm) paper shall be provided. The wireless printer shall also be equipped to copy in color and scan documents.

(j) One electric water cooler dispenser.

(k) One first-aid cabinet fully equipped.

(l) One microwave oven (minimum 700 watt) with a turntable and 1 cu ft (0.03 cu m) minimum capacity.

(m) One fire-proof safe, 0.5 cu ft (0.01 cu m) minimum capacity.

(n) One electric paper shredder.

(o) One post mounted rain gauge, located on the project site for each 5 miles (8 km) of project length."

Revise the last sentence of the first paragraph of Articles 670.04 and 670.05 of the Standard Specifications to read:

"Doors and windows shall be equipped with locks."

Revise Article 670.04(c) through 670.04(n) of the Standard Specifications to read:

"(c) Two folding chairs.

(d) One equipment cabinet of minimum inside dimension of 44 in. (1100 mm) high x 24 in. (600 mm) wide x 30 in. (750 mm) deep with lock. The walls shall be of steel with a 3/32 in. (2 mm) minimum thickness with concealed hinges and enclosed lock constructed to prevent entry by force. The cabinet assembly shall be permanently attached to a structural element of the field office to prevent theft of the entire cabinet.

(e) A minimum of two communication paths. The configuration shall include:

(1) Internet Connection. An internet service connection with a wireless router capable of providing service to a minimum of five devices. The internet service shall be for unlimited data with a minimum internet download speed of 25 megabits per second. For areas where this minimum download speed is not available, the maximum speed available for the area shall be provided.

(2) Telephone Line. One land line touch tone telephone with voicemail or answering machine. The telephone shall have an unpublished number.

(f) One electric desk type tape printing calculator.

(g) One first-aid cabinet fully equipped.

(h) One plain paper wireless color printer capable of reproducing prints up to 11 x 17 in. (280 x 432 mm) with an automatic feed tray. Separate paper trays for letter size and 11 x 17 in. (280 x 432 mm) paper shall be provided. The wireless printer shall also be equipped to copy in color and scan documents.

(i) A portable toilet meeting Federal, State, and local health department requirements shall be provided, maintained clean and in good working condition, and shall be stocked with lavatory and sanitary supplies at all times. The portable toilet shall be serviced once per week.

(j) One electric water cooler dispenser.

(k) One refrigerator with a minimum size of 14 cu ft (0.45 cu m) with a freezer unit.

(l) One microwave oven (minimum 700 watt) with a turntable and 1 cu ft (0.03 cu m) minimum capacity."

Revise Article 670.05(f) of the Standard Specifications to read:

"(f) One landline touch tone telephone with voicemail or an answering machine. The telephone shall have an unpublished number."

Delete the last sentence of the second paragraph of Article 670.06 of the Standard Specifications.

Revise the fifth sentence of the first paragraph of Article 670.07 of the Supplemental Specifications to read:

"This price shall include all utility costs and shall reflect the salvage value of the building or buildings, equipment, and furniture which remain the property of the Contractor after release by the Engineer, except the Department will pay that portion of the monthly long distance and monthly local telephone, when combined, exceed $250."

80423

EQUIPMENT PARKING AND STORAGE (BDE)

Effective: November 1, 2017

Replace the first paragraph of Article 701.11 of the Standard Specifications with the following.

"**701.11 Equipment Parking and Storage.** During working hours, all vehicles and/or nonoperating equipment which are parked, two hours or less, shall be parked at least 8 ft (2.5 m) from the open traffic lane. For other periods of time during working and for all nonworking hours, all vehicles, materials, and equipment shall be parked or stored as follows.

(a) When the project has adequate right-of-way, vehicles, materials, and equipment shall be located a minimum of 30 ft (9 m) from the pavement.

(b) When adequate right-of-way does not exist, vehicles, materials, and equipment shall be located a minimum of 15 ft (4.5 m) from the edge of any pavement open to traffic.

(c) Behind temporary concrete barrier, vehicles, materials, and equipment shall be located a minimum of 24 in. (600 mm) behind free standing barrier or a minimum of 6 in. (150 mm) behind barrier that is either pinned or restrained according to Article 704.04. The 24 in. or 6 in. measurement shall be from the base of the non-traffic side of the barrier.

(d) Behind other man-made or natural barriers meeting the approval of the Engineer."

80388

GEOTECHNICAL FABRIC FOR PIPE UNDERDRAINS AND FRENCH DRAINS (BDE)

Effective: November 1, 2019

Revise Article 1080.01(a) of the Standard Specifications to read:

"(a) Fabric Materials. Fabric materials shall be as follows.

(1) Knitted Fabric. Knitted fabric envelope shall be Type A according to ASTM D 6707 and be a continuous one piece knitted polymeric material that fits over the pipe underdrain like a sleeve. It shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

(2) Woven or Nonwoven Fabric. The fabric shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e. maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

(3) Physical Properties. The physical properties for knitted, woven, and nonwoven fabrics shall be according to the following.

PHYSICAL PROPERTIES			
	Knitted [1/]	Woven [2/]	Nonwoven [2/]
Grab Strength, lb (N) ASTM D 4632 [3/]	--	180 (800) min.	112 (500) min.
Elongation/Grab Strain, % ASTM D 4632 [3/]	--	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 [3/]	--	67 (300) min.	40 (180) min.
Puncture Strength, lb (N) ASTM D 6241 [3/]	180 (800) min.	370 (1650) min.	222 (990) min.
Apparent Opening Size, Sieve No. (mm) ASTM D 4751 [4/]	30 (0.60) max.	40 (0.425) max.	40 (0.425) max.
Permittivity, sec^{-1} ASTM D 4491	1.0 min.		
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	--	50 min.	50 min.

1/ Manufacturer's certification to meet test requirements.

2/ NTPEP results or manufacturer's certification to meet test requirements.

3/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

4/ Values represent the maximum average roll value."

Revise Article 1080.05 of the Standard Specifications to read:

"**1080.05 Geotechnical Fabric for French Drains and Pipe Underdrains, Type 2.** Geotechnical fabric for french drains and pipe underdrains, Type 2 shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e. maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

The fabric shall be according to the following.

PHYSICAL PROPERTIES 1/		
	Woven	Nonwoven
Grab Strength, lb (N) ASTM D 4632 2/	180 (800) min.	112 (500) min.
Elongation/Grab Strain, % ASTM D 4632 2/	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 2/	67 (300) min.	40 (180) min.
Puncture Strength, lb (N) ASTM D 6241 2/	370 (1650) min.	222 (990) min.
Apparent Opening Size, Sieve No. (mm) ASTM D 4751 3/	60 (0.25) max.	
Permittivity, sec^{-1} ASTM D 4491	0.2 min.	
Ultraviolet Stability % retained strength after 500 hours of exposure - ASTM D 4355	50 min.	

1/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

2/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

3/ Values represent the maximum average roll value."

80417

MANHOLES, VALVE VAULTS, AND FLAT SLAB TOPS (BDE)

Effective: January 1, 2018
Revised: March 1, 2019

Description. In addition to those manufactured according to the current standards included in this contract, manholes, valve vaults, and flat slab tops manufactured prior to March 1, 2019, according to the previous Highway Standards listed below will be accepted on this contract:

Product	Previous Standards		
Precast Manhole Type A, 4' (1.22 m) Diameter	602401-05	602401-04	602401-03
Precast Manhole Type A, 5' (1.52 m) Diameter	602402-01	602402	602401-03
Precast Manhole Type A, 6' (1.83 m) Diameter	602406-09	602406-08	602406-07
Precast Manhole Type A, 7' (2.13 m) Diameter	602411-07	602411-06	602411-05
Precast Manhole Type A, 8' (2.44 m) Diameter	602416-07	602416-06	602416-05
Precast Manhole Type A, 9' (2.74 m) Diameter	602421-07	602421-06	602421-05
Precast Manhole Type A, 10' (3.05 m) Diameter	602426-01	602426	
Precast Valve Vault Type A, 4' (1.22 m) Diameter	602501-04	602501-03	602501-02
Precast Valve Vault Type A, 5' (1.52 m) Diameter	602506-01	602506	602501-02
Precast Reinforced Concrete Flat Slab Top	602601-05	602601-04	

The following revisions to the Standard Specifications shall apply to manholes, valve vaults, and flat slab tops manufactured according to the current standards included in this contract:

Revise Article 602.02(g) of the Standard Specifications to read:

"(g) Structural Steel (Note 4) 1006.04

Note 4. All components of the manhole joint splice shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable."

Add the following to Article 602.02 of the Standard Specifications:

"(s) Anchor Bolts and Rods (Note 5) 1006.09

Note 5. The threaded rods for the manhole joint splice shall be according to the requirements of ASTM F 1554, Grade 55, (Grade 380)."

Revise the second paragraph of Article 1042.10 of the Standard Specifications to read:

"Catch basin Types A, B, C, and D; Manhole Type A; Inlet Types A and B; Drainage Structures Types 1, 2, 3, 4, 5, and 6; Valve Vault Type A; and reinforced concrete flat slab top (Highway Standard 602601) shall be manufactured according to AASHTO M 199 (M 199M), except the minimum wall thickness shall be as shown on the plans. Additionally, catch basins, inlets, and drainage structures shall have a minimum concrete compressive strength of 4500 psi

(31,000 kPa) at 28 days and manholes, valve vaults, and reinforced concrete flat slab tops shall have a minimum concrete compressive strength of 5000 psi (34,500 kPa) at 28 days."

80393

MOBILIZATION (BDE)

Effective: April 1, 2020

Replace Articles 671.02(a), (b), and (c) of the Standard Specifications with the following:

"(a) Upon execution of the contract, 90 percent of the pay item will be paid.

(b) When 90 percent of the adjusted contract value is earned, the remaining ten percent of the pay item will be paid along with any amount bid in excess of six percent of the original contract amount."

80428

PAVEMENT MARKING REMOVAL (BDE)

Effective: July 1, 2016

Revise Article 783.02 of the Standard Specifications to read:

"**783.02 Equipment.** Equipment shall be according to the following.

Item	Article/Section
(a) Grinders (Note 1)	
(b) Water Blaster with Vacuum Recovery	1101.12

Note 1. Grinding equipment shall be approved by the Engineer."

Revise the first paragraph of Article 783.03 of the Standard Specifications to read:

"**783.03 Removal of Conflicting Markings.** Existing pavement markings that conflict with revised traffic patterns shall be removed. If darkness or inclement weather prohibits the removal operations, such operations shall be resumed the next morning or when weather permits. In the event of removal equipment failure, such equipment shall be repaired, replaced, or leased so removal operations can be resumed within 24 hours."

Revise the first and second sentences of the first paragraph of Article 783.03(a) of the Standard Specifications to read:

"The existing pavement markings shall be removed by the method specified and in a manner that does not materially damage the surface or texture of the pavement or surfacing. Small particles of tightly adhering existing markings may remain in place, if in the opinion of the Engineer, complete removal of the small particles will result in pavement surface damage."

Revise the first paragraph of Article 783.04 of the Standard Specifications to read:

"**783.04 Cleaning.** The roadway surface shall be cleaned of debris or any other deleterious material by the use of compressed air or water blast."

Revise the first paragraph of Article 783.06 of the Standard Specifications to read:

"**783.06 Basis of Payment.** This work will be paid for at the contract unit price per each for RAISED REFLECTIVE PAVEMENT MARKER REMOVAL, or at the contract unit price per square foot (square meter) for PAVEMENT MARKING REMOVAL – GRINDING and/or PAVEMENT MARKING REMOVAL – WATER BLASTING."

Delete Article 1101.13 from the Standard Specifications.

80371

PORTLAND CEMENT CONCRETE (BDE)

Effective: November 1, 2017

Revise the Air Content % of Class PP Concrete in Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA		
Class of Conc.	Use	Air Content %
PP	Pavement Patching Bridge Deck Patching (10)	
	PP-1	4.0 - 8.0"
	PP-2	
	PP-3	
	PP-4	
	PP-5	

Revise Note (4) at the end of Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"(4) For all classes of concrete, the maximum slump may be increased to 7 in (175 mm) when a high range water-reducing admixture is used. For Class SC, the maximum slump may be increased to 8 in. (200 mm). For Class PS, the maximum slump may be increased to 8 1/2 in. (215 mm) if the high range water-reducing admixture is the polycarboxylate type."

80389

PORTLAND CEMENT CONCRETE – HAUL TIME (BDE)

Effective: July 1, 2020

Revise Article 1020.11(a)(7) of the Standard Specifications to read:

"(7) Haul Time. Haul time shall begin when the delivery ticket is stamped. The delivery ticket shall be stamped no later than five minutes after the addition of the mixing water to the cement, or after the addition of the cement to the aggregate when the combined aggregates contain free moisture in excess of two percent by weight (mass). If more than one batch is required for charging a truck using a stationary mixer, the time of haul shall start with mixing of the first batch. Haul time shall end when the truck is emptied for incorporation of the concrete into the work. The maximum haul time shall be as follows.

Concrete Temperature at Point of Discharge, °F (°C)	Maximum Haul Time 1/ (minutes)	
	Truck Mixer or Truck Agitator	Nonagitator Truck
50 - 64 (10 - 17.5)	90	45
> 64 (> 17.5) - without retarder	60	30
> 64 (> 17.5) - with retarder	90	45

1/ To encourage start-up testing for mix adjustments at the plant, the first two trucks will be allowed an additional 15 minutes haul time whenever such testing is performed.

For a mixture which is not mixed on the jobsite, a delivery ticket shall be required for each load. The following information shall be recorded on each delivery ticket: (1) ticket number; (2) name of producer and plant location; (3) contract number; (4) name of Contractor; (5) stamped date and time batched; (6) truck number; (7) quantity batched; (8) amount of admixture(s) in the batch; (9) amount of water in the batch; and (10) Department mix design number.

For concrete mixed in jobsite stationary mixers, the above delivery ticket may be waived, but a method of verifying the haul time shall be established to the satisfaction of the Engineer."

80430

RAILROAD PROTECTIVE LIABILITY INSURANCE (5 AND 10) (BDE)

Effective: January 1, 2006

Description. Railroad Protective Liability and Property Damage Liability Insurance shall be carried according to Article 107.11 of the Standard Specifications, except the limits shall be a minimum of $5,000,000 combined single limit per occurrence for bodily injury liability and property damage liability with an aggregate limit of $10,000,000 over the life of the policy. A separate policy is required for each railroad unless otherwise noted.

NAMED INSURED & ADDRESS	NUMBER & SPEED OF PASSENGER TRAINS	NUMBER & SPEED OF FREIGHT TRAINS
BNSF Railway Company c/o CertFocus P.O. Box 140528 Kansas City, MO 64114	103 at 79 mph	30 at 60 mph

DOT/AAR No.: 079 529S
RR Division: Chicago
RR Mile Post: 18.32
RR Sub-Division: Chicago

For Freight/Passenger Information Contact: Calvin Nutt Phone: 763-782-3495
For Insurance Information Contact: Rosa Martinez Phone: 214-303-8519

DOT/AAR No.:
RR Division:
RR Mile Post:
RR Sub-Division:

For Freight/Passenger Information Contact: Phone:
For Insurance Information Contact: Phone:

Approval of Insurance. The original and one certified copy of each required policy shall be submitted to the following address for approval:

Illinois Department of Transportation
Bureau of Design and Environment
2300 South Dirksen Parkway, Room 326
Springfield, Illinois 62764

The Contractor will be advised when the Department has received approval of the insurance from the railroad(s). Before any work begins on railroad right-of-way, the Contractor shall submit to the Engineer evidence that the required insurance has been approved by the railroad(s). The Contractor shall also provide the Engineer with the expiration date of each required policy.

Basis of Payment. Providing Railroad Protective Liability and Property Damage Liability Insurance will be paid for at the contract unit price per Lump Sum for RAILROAD PROTECTIVE LIABILITY INSURANCE.

80157

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES (BDE)

Effective: January 1, 2019
Revised: January 1, 2020

Revise Section 669 of the Standard Specifications to read:

"**SECTION 669. REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES**

669.01 Description. This work shall consist of the transportation and proper disposal of regulated substances. This work shall also consist of the removal, transportation, and proper disposal of underground storage tanks (UST), their contents and associated underground piping to the point where the piping is above the ground, including determining the content types and estimated quantities.

669.02 Equipment. The Contractor shall notify the Engineer of the delivery of all excavation, storage, and transportation equipment to a work area location. The equipment shall comply with OSHA and American Petroleum Institute (API) guidelines and shall be furnished in a clean condition. Clean condition means the equipment does not contain any residual material classified as a non-special waste, non-hazardous special waste, or hazardous waste. Residual materials include, but are not limited to, petroleum products, chemical products, sludges, or any other material present in or on equipment.

Before beginning any associated soil or groundwater management activity, the Contractor shall provide the Engineer with the opportunity to visually inspect and approve the equipment. If the equipment contains any contaminated residual material, decontamination shall be performed on the equipment as appropriate to the regulated substance and degree of contamination present according to OSHA and API guidelines. All cleaning fluids used shall be treated as the contaminant unless laboratory testing proves otherwise.

669.03 Pre-Construction Submittals and Qualifications. Prior to beginning this work, or working in areas with regulated substances, the Contractor shall submit a "Regulated Substances Pre-Construction Plan (RSPCP)" to the Engineer for review and approval using form BDE 2730. The form shall be signed by an Illinois licensed Professional Engineer or Professional Geologist.

As part of the RSPCP, the Contractor(s) or firm(s) performing the work shall meet the following qualifications.

(a) Regulated Substances Monitoring. Qualification for environmental observation and field screening of regulated substances work and environmental observation of UST removal shall require either pre-qualification in Hazardous Waste by the Department or demonstration of acceptable project experience in remediation and operations for contaminated sites in accordance with applicable Federal, State, or local regulatory requirements using BDE 2730.

Qualification for each individual performing regulated substances monitoring shall require a minimum of one-year of experience in similar activities as those required for the project.

(b) Underground Storage Tank Removal. Qualification for underground storage tank (UST) removal work shall require licensing and certification with the Office of the State Fire Marshall (OSFM) and possession of all permits required to perform the work. A copy of the permit shall be provided to the Engineer prior to tank removal.

The qualified Contractor(s) or firm(s) shall also document it does not have any current or former ties with any of the properties contained within, adjoining, or potentially affecting the work.

The Engineer will require up to 21 calendar days for review of the RSPCP. The review may involve rejection or revision and resubmittal; in which case, an additional 21 days will be required for each subsequent review. Work shall not commence until the RSPCP has been approved by the Engineer. After approval, the RSPCP shall be revised as necessary to reflect changed conditions in the field and documented using BDE 2730A "Regulated Substances Pre-Construction Plan (RSPCP) Addendum" and submitted to the Engineer for approval.

CONSTRUCTION REQUIREMENTS

669.04 Regulated Substances Monitoring. Regulated substances monitoring includes environmental observation and field screening during regulated substances management activities at the contract specific work areas. As part of the regulated substances monitoring, the monitoring personnel shall perform and document the applicable duties listed on form BDE 2732 "Regulated Substances Monitoring Daily Record (RSMDR)".

(a) Environmental Observation. Prior to beginning excavation, the Contractor shall mark the limits of the contract specific work areas. Once work begins, the monitoring personnel shall be present on-site continuously during the excavation and loading of material.

(b) Field Screening. Field screening shall be performed during the excavation and loading of material from the contract specific work areas, except for material classified according to Article 669.05(b)(1) or 669.05(c) where field screening is not required.

Field screening shall be performed with either a photoionization detector (PID) (minimum 10.6eV lamp) or a flame ionization detector (FID), and other equipment as appropriate, to monitor for potential contaminants associated with regulated substances. The PID or FID shall be calibrated on-site, and background level readings taken and recorded daily, and as field and weather conditions change. Field screen readings on the PID or FID in excess of background levels indicates the potential presence of regulated substances requiring handling as a non-special waste, special waste, or hazardous waste. PID or FID readings may be used as the basis of increasing the limits of removal with the approval of the Engineer but shall in no case be used to decrease the limits.

669.05 Regulated Substances Management and Disposal. The management and disposal of soil and/or groundwater containing regulated substances shall be according to the following:

(a) Soil Analytical Results Exceed Most Stringent MAC. When the soil analytical results indicate detected levels exceed the most stringent maximum allowable concentration (MAC) for chemical constituents in soil established pursuant to Subpart F of 35 Ill. Adm. Code 1100.605, the soil shall be managed as follows:

(1) When analytical results indicate inorganic chemical constituents exceed the most stringent MAC, but still considered within area background levels by the Engineer, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable. If the soils cannot be utilized within the right-of-way, they shall be managed and disposed of at a landfill as a non-special waste.

(2) When analytical results indicate inorganic chemical constituents exceed the most stringent MAC but do not exceed the MAC for a Metropolitan Statistical Area (MSA) County identified in 35 Ill. Admin. Code 742 Appendix A. Table G, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of at a clean construction and demolition debris (CCDD) facility or an uncontaminated soil fill operation (USFO) within an MSA County provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(3) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, or the MAC within the Chicago corporate limits, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site at a CCDD facility or an USFO within an MSA County excluding Chicago or within the Chicago corporate limits provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(4) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site at a CCDD facility or an USFO within an MSA County excluding Chicago provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(5) When the Engineer determines soil cannot be managed according to Articles 669.05(a)(1) through (a)(4) above and the materials do not contain special waste or hazardous waste, as determined by the Engineer, the soil shall be managed and disposed of at a landfill as a non-special waste.

(6) When analytical results indicate soil is hazardous by characteristic or listing pursuant to 35 Ill. Admin. Code 721, contains radiological constituents, or the Engineer otherwise determines the soil cannot be managed according to Articles 669.05(a)(1)

through (a)(5) above, the soil shall be managed and disposed of off-site as a special waste or hazardous waste as applicable.

(b) Soil Analytical Results Do Not Exceed Most Stringent MAC. When the soil analytical results indicate that detected levels do not exceed the most stringent MAC, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site according to Article 202.03. However, the excavated soil cannot be taken to a CCDD facility or an USFO for any of the following reasons.

(1) The pH of the soil is less than 6.25 or greater than 9.0.

(2) The soil exhibited PID or FID readings in excess of background levels.

(c) Soil Analytical Results Exceed Most Stringent MAC but Do Not Exceed Tiered Approach to Corrective Action Objectives (TACO) Residential. When the soil analytical results indicate that detected levels exceed the most stringent MAC but do not exceed TACO Tier 1 Soil Remediation Objectives for Residential Properties pursuant to 35 Ill. Admin. Code 742 Appendix B Table A, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site according to Article 202.03. However, the excavated soil cannot be taken to a CCDD facility or an USFO.

(d) Groundwater. When groundwater analytical results indicate the detected levels are above Appendix B, Table E of 35 Ill. Admin. Code 742, the most stringent Tier 1 Groundwater Remediation Objectives for Groundwater Component of the Groundwater Ingestion Route for Class 1 groundwater, the groundwater shall be managed off-site as a special waste or hazardous waste as applicable. Special waste groundwater shall be containerized and trucked to an off-site treatment facility, or may be discharged to a sanitary sewer or combined sewer when permitted by the local sewer authority. Groundwater discharged to a sanitary sewer or combined sewer shall be pre-treated to remove particulates and measured with a calibrated flow meter to comply with applicable discharge limits. A copy of the permit shall be provided to the Engineer prior to discharging groundwater to the sanitary sewer or combined sewer.

Groundwater encountered within trenches may be managed within the trench and allowed to infiltrate back into the ground. If the groundwater cannot be managed within the trench, it may be discharged to a sanitary sewer or combined sewer when permitted by the local sewer authority, or it shall be containerized and trucked to an off-site treatment facility as a special waste or hazardous waste. The Contractor is prohibited from discharging groundwater within the trench through a storm sewer. The Contractor shall install backfill plugs within the area of groundwater contamination.

One backfill plug shall be placed down gradient to the area of groundwater contamination. Backfill plugs shall be installed at intervals not to exceed 50 ft (15 m). Backfill plugs are to be 4 ft (1.2 m) long, measured parallel to the trench, full trench width and depth. Backfill plugs shall not have any fine aggregate bedding or backfill, but shall be entirely cohesive

soil or any class of concrete. The Contractor shall provide test data that the material has a permeability of less than 10^{-7} cm/sec according to ASTM D 5084, Method A or per another test method approved by the Engineer.

The Contractor shall use due care when transferring contaminated material from the area of origin to the transporter. Should releases of contaminated material to the environment occur (i.e., spillage onto the ground, etc.), the Contractor shall clean-up spilled material and place in the appropriate storage containers as previously specified. Clean-up shall include, but not be limited to, sampling beneath the material staging area to determine complete removal of the spilled material.

The Contractor shall provide engineered barriers, when required, and shall include materials sufficient to completely line excavation surfaces, including sloped surfaces, bottoms, and sidewall faces, within the areas designated for protection.

The Contractor shall obtain all documentation including any permits and/or licenses required to transport the material containing regulated substances to the disposal facility. The Contractor shall coordinate with the Engineer on the completion of all documentation. The Contractor shall make all arrangements for collection and analysis of landfill acceptance testing. The Contractor shall coordinate waste disposal approvals with the disposal facility.

The Contractor shall provide the Engineer with all transport-related documentation within two days of transport or receipt of said document(s). For management of special or hazardous waste, the Contractor shall provide the Engineer with documentation that the Contractor is operating with a valid Illinois special waste transporter permit at least two weeks before transporting the first load of contaminated material.

Transportation and disposal of material classified according to Article 669.05(a)(5) or 669.05(a)(6) shall be completed each day so that none of the material remains on-site by the close of business, except when temporary staging has been approved.

Any waste generated as a special or hazardous waste from a non-fixed facility shall be manifested off-site using the Department's county generator number provided by the Bureau of Design and Environment. An authorized representative of the Department shall sign all manifests for the disposal of the contaminated material and confirm the Contractor's transported volume. Any waste generated as a non-special waste may be managed off-site without a manifest, a special waste transporter, or a generator number.

The Contractor shall select a landfill permitted for disposal of the contaminant within the State of Illinois. The Department will review and approve or reject the facility proposed by the Contractor to use as a landfill. The Contractor shall verify whether the selected disposal facility is compliant with those applicable standards as mandated by their permit and whether the disposal facility is presently, has previously been, or has never been, on the United States Environmental Protection Agency (U.S. EPA) National Priorities List or the Resource Conservation and Recovery Act (RCRA) List of Violating Facilities. The use of a Contractor selected landfill shall in no manner delay the construction schedule or alter the Contractor's responsibilities as set forth.

669.06 Non-Special Waste Certification. An authorized representative of the Department shall sign and date all non-special waste certifications. The Contractor shall be responsible for providing the Engineer with the required information that will allow the Engineer to certify the waste is not a special waste.

(a) Definition. A waste is considered a non-special waste as long as it is not:

(1) a potentially infectious medical waste;

(2) a hazardous waste as defined in 35 Ill. Admin. Code 721;

(3) an industrial process waste or pollution control waste that contains liquids, as determined using the paint filter test set forth in subdivision (3)(A) of subsection (m) of 35 Ill. Admin. Code 811.107;

(4) a regulated asbestos-containing waste material, as defined under the National Emission Standards for Hazardous Air Pollutants in 40 CFR Part 61.141;

(5) a material containing polychlorinated biphenyls (PCB's) regulated pursuant to 40 CFR Part 761;

(6) a material subject to the waste analysis and recordkeeping requirements of 35 Ill. Admin. Code 728.107 under land disposal restrictions of 35 Ill. Admin. Code 728;

(7) a waste material generated by processing recyclable metals by shredding and required to be managed as a special waste under Section 22.29 of the Environmental Protection Act; or

(8) an empty portable device or container in which a special or hazardous waste has been stored, transported, treated, disposed of, or otherwise handled.

(b) Certification Information. All information used to determine the waste is not a special waste shall be attached to the certification. The information shall include but not be limited to:

(1) the means by which the generator has determined the waste is not a hazardous waste;

(2) the means by which the generator has determined the waste is not a liquid;

(3) if the waste undergoes testing, the analytic results obtained from testing, signed and dated by the person responsible for completing the analysis;

(4) if the waste does not undergo testing, an explanation as to why no testing is needed;

(5) a description of the process generating the waste; and

(6) relevant material safety data sheets.

669.07 Temporary Staging. Soil classified according to Articles 669.05(a)(2), (b)(1), or (c) may be temporarily staged at the Contractor's option. Soil classified according to Articles 669.05(a)(1), (a)(3), (a)(4), (a)(5), (a)(6), or (b)(2) shall be managed and disposed of without temporary staging to the greatest extent practicable. If circumstances beyond the Contractor's control require temporary staging of these latter materials, the Contractor shall request approval from the Engineer in writing.

Temporary staging shall be accomplished within the right-of-way and the Contractor's means and methods shall be described in the approved or amended RSPCP. Staging areas shall not be located within 200 feet (61 m) of a public or private water supply well; nor within 100 feet (30 m) of sensitive environmental receptor areas, including wetlands, rivers, streams, lakes, or designated habitat zones.

The method of staging shall consist of containerization or stockpiling as applicable for the type, classification, and physical state (i.e., liquid, solid, semisolid) of the material. Materials of different classifications shall be staged separately with no mixing or co-mingling.

When containers are used, the containers and their contents shall remain intact and inaccessible to unauthorized persons until the manner of disposal is determined. The Contractor shall be responsible for all activities associated with the storage containers including, but not limited to, the procurement, transport, and labeling of the containers. The Contractor shall not use a storage container if visual inspection of the container reveals the presence of free liquids or other substances that could cause the waste to be reclassified as a hazardous or special waste.

When stockpiles are used, they shall be covered with a minimum 20-mil plastic sheeting or tarps secured using weights or tie-downs. Perimeter berms or diversionary trenches shall be provided to contain and collect for disposal any water that drains from the soil. Stockpiles shall be managed to prevent or reduce potential dust generation.

When staging non-special waste, special waste, or hazardous waste, the following additional requirements shall apply:

(a) Non-Special Waste. When stockpiling soil classified according to Article 669.05(a)(1) or 669.05(a)(5), an impermeable surface barrier between the materials and the ground surface shall be installed. The impermeable barrier shall consist of a minimum 20-mil plastic liner material and the surface of the stockpile area shall be clean and free of debris prior to placement of the liner. Measures shall also be taken to limit or discourage access to the staging area.

(b) Special Waste and Hazardous Waste. Soil classified according to Article 669.05(a)(6) shall not be stockpiled but shall be containerized immediately upon generation in containers, tanks or containment buildings as defined by RCRA, Toxic Substances Control

Act (TSCA), and other applicable State or local regulations and requirements, including 35 Ill. Admin. Code Part 722, Standards Applicable to Generators of Hazardous Waste.

The staging area(s) shall be enclosed (by a fence or other structure) to restrict direct access to the area, and all required regulatory identification signs applicable to a staging area containing special waste or hazardous waste shall be deployed.

Storage containers shall be placed on an all-weather gravel-packed, asphalt, or concrete surface. Containers shall be in good condition and free of leaks, large dents, or severe rusting, which may compromise containment integrity. Containers must be constructed of, or lined with, materials that will not react or be otherwise incompatible with the hazardous or special waste contents. Containers used to store liquids shall not be filled more than 80 percent of the rated capacity. Incompatible wastes shall not be placed in the same container or comingled.

All containers shall be legibly labeled and marked using pre-printed labels and permanent marker in accordance with applicable regulations, clearly showing the date of waste generation, location and/or area of waste generation, and type of waste. The Contractor shall place these identifying markings on an exterior side surface of the container.

Storage containers shall be kept closed, and storage pads covered, except when access is needed by authorized personnel.

Special waste and hazardous waste shall be transported and disposed within 90 days from the date of generation.

669.08 Underground Storage Tank Removal. For the purposes of this section, an underground storage tank (UST) includes the underground storage tank, piping, electrical controls, pump island, vent pipes and appurtenances.

Prior to removing an UST, the Engineer shall determine whether the Department is considered an "owner" or "operator" of the UST as defined by the UST regulations (41 Ill. Adm. Code Part 176). Ownership of the UST refers to the Department's owning title to the UST during storage, use or dispensing of regulated substances. The Department may be considered an "operator" of the UST if it has control of, or has responsibility for, the daily operation of the UST. The Department may however voluntarily undertake actions to remove an UST from the ground without being deemed an "operator" of the UST.

In the event the Department is deemed not to be the "owner" or "operator" of the UST, the OSFM removal permit shall reflect who was the past "owner" or "operator" of the UST. If the "owner" or "operator" cannot be determined from past UST registration documents from OSFM, then the OSFM removal permit will state the "owner" or "operator" of the UST is the Department. The Department’s Office of Chief Counsel (OCC) will review all UST removal permits prior to submitting any removal permit to the OSFM. If the Department is not the “owner” or “operator” of the UST then it will not register the UST or pay any registration fee.

The Contractor shall be responsible for obtaining permits required for removing the UST, notification to the OSFM, using an OSFM certified tank contractor, removal and disposal of the UST and its contents, and preparation and submittal of the OSFM Site Assessment Report in accordance with 41 Ill. Admin. Code Part 176.330.

The Contractor shall contact the Engineer and the OSFM's office at least 72 hours prior to removal to confirm the OSFM inspector's presence during the UST removal. Removal, transport, and disposal of the UST shall be according to the applicable portions of the latest revision of the "American Petroleum Institute (API) Recommended Practice 1604".

The Contractor shall collect and analyze tank content (sludge) for disposal purposes. The Contractor shall remove as much of the regulated substance from the UST system as necessary to prevent further release into the environment. All contents within the tank shall be removed, transported and disposed of, or recycled. The tank shall be removed and rendered empty according to IEPA definition.

The Contractor shall collect soil samples from the bottom and sidewalls of the excavated area in accordance with 35 Ill. Admin. Code Part 734.210(h) after the required backfill has been removed during the initial response action, to determine the level of contamination remaining in the ground, regardless if a release is confirmed or not by the OSFM on-site inspector.

In the event the UST is designated a leaking underground storage tank (LUST) by the OSFM's inspector, or confirmation by analytical results, the Contractor shall notify the Engineer and the District Environmental Studies Unit (DESU). Upon confirmation of a release of contaminants and notifications to the Engineer and DESU, the Contractor shall report the release to the Illinois Emergency Management Agency (IEMA) (e.g., by telephone or electronic mail) and provide them with whatever information is available ("owner" or "operator" shall be stated as the past registered "owner" or "operator", or the IDOT District in which the tank is located and the DESU Manager).

The Contractor shall perform the following initial response actions if a release is indicated by the OSFM inspector:

(a) Take immediate action to prevent any further release of the regulated substance to the environment, which may include removing, at the Engineer's discretion, and disposing of up to 4 ft (1.2 m) of the contaminated material, as measured from the outside dimension of the tank;

(b) Identify and mitigate fire, explosion and vapor hazards;

(c) Visually inspect any above ground releases or exposed below ground releases and prevent further migration of the released substance into surrounding soils and groundwater; and

(d) Continue to monitor and mitigate any additional fire and safety hazards posed by vapors and free product that have migrated from the tank excavation zone and entered into subsurface structures (such as sewers or basements).

The tank excavation shall be backfilled according to applicable portions of Sections 205, 208, and 550 with a material that will compact and develop stability. All uncontaminated concrete and soil removed during tank extraction may be used to backfill the excavation, at the discretion of the Engineer.

After backfilling the excavation, the site shall be graded and cleaned.

669.09 Regulated Substances Final Construction Report. Not later than 90 days after completing this work, the Contractor shall submit a "Regulated Substances Final Construction Report (RSFCR)" to the Engineer using form BDE 2733 and required attachments. The form shall be signed by an Illinois licensed Professional Engineer or Professional Geologist.

669.10 Method of Measurement. Non-special waste, special waste, and hazardous waste soil will be measured for payment according to Article 202.07(b) when performing earth excavation, Article 502.12(b) when excavating for structures, or by computing the volume of the trench using the maximum trench width permitted and the actual depth of the trench.

Groundwater containerized and transported off-site for management, storage, and disposal will be measured for payment in gallons (liters).

Backfill plugs will be measured in cubic yards (cubic meters) in place, except the quantity for which payment will be made shall not exceed the volume of the trench, as computed by using the maximum width of trench permitted by the Specifications and the actual depth of the trench, with a deduction for the volume of the pipe.

Engineered Barriers will be measured for payment in square yards (square meters).

669.11 Basis of Payment. The work of preparing, submitting and administering a Regulated Substances Pre-Construction Plan will be paid for at the contract lump sum price for REGULATED SUBSTANCES PRE-CONSTRUCTION PLAN.

Regulated substances monitoring, including completion of form BDE 2732 for each day of work, will be paid for at the contract unit price per calendar day, or fraction thereof to the nearest 0.5 calendar day, for REGULATED SUBSTANCES MONITORING.

The installation of engineered barriers will be paid for at the contract unit price per square yard (square meter) for ENGINEERED BARRIER.

The work of UST removal, soil excavation, soil and content sampling, the management of excavated soil and UST content, and UST disposal, will be paid for at the contract unit price per each for UNDERGROUND STORAGE TANK REMOVAL.

The transportation and disposal of soil and other materials from an excavation determined to be contaminated will be paid for at the contract unit price per cubic yard (cubic meter) for

NON-SPECIAL WASTE DISPOSAL, SPECIAL WASTE DISPOSAL, or HAZARDOUS WASTE DISPOSAL.

The transportation and disposal of groundwater from an excavation determined to be contaminated will be paid for at the contract unit price per gallon (liter) for SPECIAL WASTE GROUNDWATER DISPOSAL or HAZARDOUS WASTE GROUNDWATER DISPOSAL. When groundwater is discharged to a sanitary or combined sewer by permit, the cost will be paid for according to Article 109.05.

Backfill plugs will be paid for at the contract unit price per cubic yard (cubic meter) for BACKFILL PLUGS.

Payment for temporary staging of soil classified according to Articles 669.05(a)(1), (a)(3), (a)(4), (a)(5), (a)(6), or (b)(2) will be paid for according to Article 109.04. The Department will not be responsible for any additional costs incurred, if mismanagement of the staging area, storage containers, or their contents by the Contractor results in excess cost expenditure for disposal or other material management requirements.

Payment for accumulated stormwater removal and disposal will be according to Article 109.04. Payment will only be allowed if appropriate stormwater and erosion control methods were used.

Payment for decontamination, labor, material, and equipment for monitoring areas beyond the specified areas, with the Engineer's prior written approval, will be according to Article 109.04.

When the waste material for disposal requires sampling for landfill disposal acceptance, the samples shall be analyzed for TCLP VOCs, SVOCs, RCRA metals, pH, ignitability, and paint filter test. The analysis will be paid for at the contract unit price per each for SOIL DISPOSAL ANALYSIS using EPA Methods 1311 (extraction), 8260B for VOCs, 8270C for SVOCs, 6010B and 7470A for RCRA metals, 9045C for pH, 1030 for ignitability, and 9095A for paint filter.

The work of preparing, submitting and administering a Regulated Substances Final Construction Report will be paid for at the contract lump sum price REGULATED SUBSTANCES FINAL CONSTRUCTION REPORT."

80407

SILT FENCE, INLET FILTERS, GROUND STABILIZATION AND RIPRAP FILTER FABRIC (BDE)

Effective: November 1, 2019
Revised: April 1, 2020

Revise Article 280.02(m) and add Article 280.02(n) so the Standard Specifications read:

"(m) Above Grade Inlet Filter (Fitted)..... 1081.15(j)
(n) Above Grade Inlet Filter (Non-Fitted).....1081.15(k)"

Revise the last sentence of the first paragraph in Article 280.04(c) of the Standard Specifications to read:

"The protection shall be constructed with hay or straw bales, silt filter fence, above grade inlet filters (fitted and non-fitted), or inlet filters.

Revise the first sentence of the second paragraph in Article 280.04(c) of the Standard Specifications to read:

"When above grade inlet filters (fitted and non-fitted) are specified, they shall be of sufficient size to completely span and enclose the inlet structure."

Revise Article 1080.02 of the Standard Specifications to read:

"**1080.02 Geotextile Fabric.** The fabric for silt filter fence shall consist of woven fabric meeting the requirements of AASHTO M 288 for unsupported silt fence.

The fabric for ground stabilization shall consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven fabrics shall be Class 2 and nonwoven fabrics shall be Class 1 according to AASHTO M 288.

The physical properties for silt fence and ground stabilization fabrics shall be according to the following.

PHYSICAL PROPERTIES			
	Silt Fence Woven [1/]	Ground Stabilization Woven [2/]	Ground Stabilization Nonwoven [2/]
Grab Strength, lb (N) [3/] ASTM D 4632	123 (550) MD 101 (450) XD	247 (1100) min. [4/]	202 (900) min. [4/]
Elongation/Grab Strain, % ASTM D 4632 [4/]	49 max.	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 [4/]	--	90 (400) min.	79 (350) min.

Puncture Strength, lb (N) ASTM D 6241 [4/]	--	494 (2200) min.	433 (1925) min.
Apparent Opening Size, Sieve No. (mm) ASTM D 4751 [5/]	30 (0.60) max.	40 (0.43) max.	40 (0.43) max.
Permittivity, sec^{-1} ASTM D 4491	0.05 min.		
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	70 min.	50 min.	50 min.

1/ NTPEP results or manufacturer's certification to meet test requirements.

2/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

3/ MD = Machine direction. XD = Cross-machine direction.

4/ Values represent the minimum average roll value (MARV) in the weaker principle direction, MD or XD.

5/ Values represent the maximum average roll value."

Revise Article 1080.03 of the Standard Specifications to read:

"**1080.03 Filter Fabric.** The filter fabric shall consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven fabrics shall be Class 3 for riprap gradations RR 4 and RR 5, and Class 2 for RR 6 and RR 7 according to AASHTO M 288. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. Nonwoven fabrics shall be Class 2 for riprap gradations RR 4 and RR 5, and Class 1 for RR 6 and RR 7 according to AASHTO M 288. After forming, the fabric shall be processed so that the yarns or filaments retain their relative positions with respect to each other. The fabric shall be new and undamaged.

The filter fabric shall be manufactured in widths of not less than 6 ft (2 m). Sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the yarns or filaments to form fabric widths as required. The sheets of filter fabric shall be sewn together at the point of manufacture or another approved location.

The filter fabric shall be according to the following.

PHYSICAL PROPERTIES [1/]				
	Gradation Nos. RR 4 & RR 5		Gradation Nos. RR 6 & RR 7	
	Woven	Nonwoven	Woven	Nonwoven
Grab Strength, lb (N) ASTM D 4632 [2/]	180 (800) min.	157 (700) min.	247 (1100) min.	202 (900) min.
Elongation/Grab Strain, % ASTM D 4632 [2/]	49 max.	50 min.	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 [2/]	67 (300) min.	56 (250) min.	90 (400) min.	79 (350) min.
Puncture Strength, lb (N) ASTM D 6241 [2/]	370 (1650) min.	309 (1375) min.	494 (2200) min.	433 (1925) min.
Ultraviolet Stability, % retained strength after 500 hours of exposure - ASTM D 4355	50 min.			

1/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

2/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

As determined by the Engineer, the filter fabric shall meet the requirements noted in the following after an onsite investigation of the soil to be protected.

Soil by Weight (Mass) Passing the No. 200 sieve (75 µm), %	Apparent Opening Size, Sieve No. (mm) - ASTM D 4751 [1/]	Permittivity, sec^{-1} ASTM D 4491
49 max.	60 (0.25) max.	0.2 min.
50 min.	70 (0.22) max.	0.1 min.

1/ Values represent the maximum average roll value."

Revise Article 1081.15(h)(3)a of the Standard Specifications to read:

"a. Inner Filter Fabric Bag. The inner filter fabric bag shall be constructed of woven yarns or nonwoven filaments made of polyolefins or polyesters with a minimum silt and debris capacity of 2.0 cu ft (0.06 cu m). Woven fabric shall be Class 3 and nonwoven fabric shall be Class 2 according to AASHTO M 288. The fabric bag shall be according to the following.

PHYSICAL PROPERTIES		
	Woven	Nonwoven
Grab Strength, lb (N) ASTM D 4632 1/	180 (800) min.	157 (700) min.
Elongation/Grab Strain, % ASTM D 4632 1/	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 1/	67 (300) min.	56 (250) min.
Puncture Strength, lb (N) ASTM D 6241 1/	370 (1650) min.	309 (1375) min.
Apparent Opening Size, Sieve No. (mm) ASTM D 4751 2/	60 (0.25) max.	
Permittivity, sec^{-1} ASTM D 4491	2.0 min.	
Ultraviolet Stability, % retained strength after 500 hours of exposure – ASTM D 4355	70 min.	

1/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

2/ Values represent the maximum average roll value."

Revise Article 1081.15(i)(1) of the Standard Specifications to read:

"(i) Urethane Foam/Geotextile. Urethane foam/geotextile shall be triangular shaped having a minimum height of 10 in. (250 mm) in the center with equal sides and a minimum 20 in. (500 mm) base. The triangular shaped inner material shall be a low density urethane foam. The outer geotextile fabric cover shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters placed around the inner material and shall extend beyond both sides of the triangle a minimum of 18 in. (450 mm). Woven filter fabric shall be Class 3 and nonwoven filter fabric shall be Class 2 according to AASHTO M 288.

(1) The geotextile shall meet the following properties.

PHYSICAL PROPERTIES		
	Woven	Nonwoven
Grab Strength, lb (N) ASTM D 4632 1/	180 (800) min.	157 (700) min.
Elongation/Grab Strain, % ASTM D 4632 1/	49 max.	50 min.
Trapezoidal Tear Strength, lb (N) ASTM D 4533 1/	67 (300) min.	56 (250) min.
Puncture Strength, lb (N) ASTM D 6241 1/	370 (1650) min.	309 (1375) min.

Apparent Opening Size, Sieve No. (mm) ASTM D 4751 2/	30 (0.60) max.
Permittivity, sec^{-1} ASTM D 4491	2.0 min.
Ultraviolet Stability, % retained strength after 500 hours of exposure – ASTM D 4355	70 min.

1/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

2/ Values represent the maximum average roll value."

Add the following to Article 1081.15(i) of the Standard Specifications.

"(3) Certification. The manufacturer shall furnish a certificate with each shipment of urethane foam/geotextile assemblies stating the amount of product furnished and that the material complies with these requirements."

Revise the title and first sentence of Article 1081.15(j) of the Standards Specifications to read:

"(j) Above Grade Inlet Filters (Fitted). Above grade inlet filters (fitted) shall consist of a rigid polyethylene frame covered with a fitted geotextile filter fabric."

Revise Article 1081.15(j)(2) of the Standard Specifications to read:

(2) Fitted Geotextile Filter Fabric. The fitted geotextile filter fabric shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters. Woven filter fabric shall be Class 3 and nonwoven filter fabric shall be Class 2 according to AASHTO M 288. The filter shall be fabricated to provide a direct fit to the frame. The top of the filter shall integrate a coarse screen with a minimum apparent opening size of 1/2 in. (13 mm) to allow large volumes of water to pass through in the event of heavy flows. The filter shall have integrated anti-buoyancy pockets capable of holding a minimum of 3.0 cu ft (0.08 cu m) of stabilization material. Each filter shall have a label with the following information sewn to or otherwise permanently adhered to the outside: manufacturer's name, product name, and lot, model, or serial number. The fitted geotextile filter fabric shall be according to the table in Article 1081.15(h)(3)a above."

Add Article 1081.15(k) to the Standard Specifications to read:

"(k) Above Grade Inlet Filters (Non-Fitted). Above grade inlet filters (non-fitted) shall consist of a geotextile fabric surrounding a metal frame. The frame shall consist of either a) a circular cage formed of welded wire mesh, or b) a collapsible aluminum frame, as described below.

(1) Frame Construction.

a) Welded Wire Mesh Frame. The frame shall consist of 6 in. x 6 in. (150 mm x 150 mm) welded wire mesh formed of #10 gauge (3.42 mm) steel conforming to ASTM A 185. The mesh shall be 30 in. (750 mm) tall and formed into a 42 in. (1.05 m) minimum diameter cylinder.

b) Collapsible Aluminum Frame. The collapsible aluminum frame shall consist of grade 6036 aluminum. The frame shall have anchor lugs that attach it to the inlet grate, which shall resist movement from water and debris. The collapsible joints of the frame shall have a locking device to secure the vertical members in place, which shall prevent the frame from collapsing while under load from water and debris.

(2) Geotextile Fabric. The geotextile fabric shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters. The woven filter fabric shall be a Class 3 and the nonwoven filter fabric shall be a Class 2 according to AASHTO M 288. The geotextile fabric shall be according to the table in Article 1081.15(h)(3)a above.

(3) Geotechnical Fabric Attachment to the Frame.

a) Welded Wire Mesh Frame. The woven or nonwoven geotextile fabric shall be wrapped 3 in. (75 mm) over the top member of a 6 in. x 6 in. (150 mm x 150 mm) welded wire mesh frame and secured with fastening rings constructed of wire conforming to ASTM A 641, A 809, A 370, and A 938 at 6 in. (150 mm) on center. The fastening rings shall penetrate both layers of geotextile and securely close around the steel mesh. The geotextile shall be secured to the sides of the welded wire mesh with fastening rings at a spacing of 1 per sq ft (11 per sq m) and securely close around a steel member.

b) Collapsible Aluminum Frame. The woven or nonwoven fabric shall be secured to the aluminum frame along the top and bottom of the frame perimeter with strips of aluminum secured to the perimeter member, such that the anchoring system provides a uniformly distributed stress throughout the geotechnical fabric.

(4) Certification. The manufacturer shall furnish a certificate with each shipment of above grade inlet filter assemblies stating the amount of product furnished and that the material complies with these requirements."

80419

SUBCONTRACTOR AND DBE PAYMENT REPORTING (BDE)

Effective: April 2, 2018

Add the following to Section 109 of the Standard Specifications.

"**109.14 Subcontractor and Disadvantaged Business Enterprise Payment Reporting.** The Contractor shall report all payments made to the following parties:

(a) first tier subcontractors;

(b) lower tier subcontractors affecting disadvantaged business enterprise (DBE) goal credit;

(c) material suppliers or trucking firms that are part of the Contractor's submitted DBE utilization plan.

The report shall be made through the Department's on-line subcontractor payment reporting system within 21 days of making the payment."

80397

SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE)

Effective: November 2, 2017
Revised: April 1, 2019

Replace the second paragraph of Article 109.12 of the Standard Specifications with the following:

"This mobilization payment shall be made at least seven days prior to the subcontractor starting work. The amount paid shall be at the following percentage of the amount of the subcontract reported on form BC 260A submitted for the approval of the subcontractor's work.

Value of Subcontract Reported on Form BC 260A	Mobilization Percentage
Less than $10,000	25%
$10,000 to less than $20,000	20%
$20,000 to less than $40,000	18%
$40,000 to less than $60,000	16%
$60,000 to less than $80,000	14%
$80,000 to less than $100,000	12%
$100,000 to less than $250,000	10%
$250,000 to less than $500,000	9%
$500,000 to $750,000	8%
Over $750,000	7%"

80391

TEMPORARY PAVEMENT MARKING (BDE)

Effective: April 1, 2012
Revised: April 1, 2017

Revise Article 703.02 of the Standard Specifications to read:

"**703.02 Materials.** Materials shall be according to the following.

(a) Pavement Marking Tape, Type I and Type III 1095.06
(b) Paint Pavement Markings 1095.02
(c) Pavement Marking Tape, Type IV ..... 1095.11"

Revise the second paragraph of Article 703.05 of the Standard Specifications to read:

"Type I marking tape or paint shall be used at the option of the Contractor, except paint shall not be applied to the final wearing surface unless authorized by the Engineer for late season applications where tape adhesion would be a problem. Type III or Type IV marking tape shall be used on the final wearing surface when the temporary pavement marking will conflict with the permanent pavement marking such as on tapers, crossovers and lane shifts."

Revise Article 703.07 of the Standard Specifications to read:

"**703.07 Basis of Payment.** This work will be paid for as follows.

a) Short Term Pavement Marking. Short term pavement marking will be paid for at the contract unit price per foot (meter) for SHORT TERM PAVEMENT MARKING. Removal of short term pavement markings will be paid for at the contract unit price per square foot (square meter) for SHORT TERM PAVEMENT MARKING REMOVAL.

b) Temporary Pavement Marking. Where the Contractor has the option of material type, temporary pavement marking will be paid for at the contract unit price per foot (meter) for TEMPORARY PAVEMENT MARKING of the line width specified, and at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING LETTERS AND SYMBOLS.

Where the Department specifies the use of pavement marking tape, the Type III or Type IV temporary pavement marking will be paid for at the contract unit price per foot (meter) for PAVEMENT MARKING TAPE, TYPE III or PAVEMENT MARKING TAPE, TYPE IV of the line width specified and at the contract unit price per square feet (square meter) for PAVEMENT MARKING TAPE, TYPE III - LETTERS AND SYMBOLS or PAVEMENT MARKING TAPE, TYPE IV – LETTERS AND SYMBOLS.

Removal of temporary pavement markings will be paid for at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING REMOVAL.

When temporary pavement marking is shown on the Standard, the cost of the temporary pavement marking and its removal will be included in the cost of the Standard."

Add the following to Section 1095 of the Standard Specifications:

"**1095.11 Pavement Marking Tape, Type IV.** The temporary, preformed, patterned markings shall consist of a white or yellow tape with wet retroreflective media incorporated to provide immediate and continuing retroreflection during both wet and dry conditions. The tape shall be manufactured without the use of heavy metals including lead chromate pigments or other similar, lead-containing chemicals.

The white and yellow Type IV marking tape shall meet the Type III requirements of Article 1095.06 and the following.

(a) Composition. The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a layer of wet retroreflective media bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately 40% ± 10% of the surface area raised and presenting a near vertical face to traffic from any direction. The channels between the raised areas shall be substantially free of exposed beads or particles.

(b) Retroreflectance. The white and yellow markings shall meet the following for initial dry and wet retroreflectance.

(1) Dry Retroreflectance. Dry retroreflectance shall be measured under dry conditions according to ASTM D 4061 and meet the values described in Article 1095.06 for Type III tape.

(2) Wet Retroreflectance. Wet retroreflectance shall be measured under wet conditions according to ASTM E 2177 and meet the values shown in the following table.

Wet Retroreflectance, Initial R_L

Color	R_L 1.05/88.76
White	300
Yellow	200

(c) Color. The material shall meet the following requirements for daylight reflectance and color, when tested, using a color spectrophotometer with 45 degrees circumferential/zero degree geometry, illuminant D65, and a two degree observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength measurement interval and spectral bandpass of 10 nm.

Color	Daylight Reflectance %Y
White	65 minimum
*Yellow	36-59

*Shall match Federal 595 Color No. 33538 and the chromaticity limits as follows.

x	0.490	0.475	0.485	0.530
y	0.470	0.438	0.425	0.456

(d) Skid Resistance. The surface of the markings shall provide an average minimum skid resistance of 50 BPN when tested according to ASTM E 303.

(e) Sampling, Testing, Acceptance, and Certification. Prior to approval and use of the wet reflective, temporary, removable pavement marking tape, the manufacturer shall submit a notarized certification from an independent laboratory, together with the results of all tests, stating that the material meets the requirements as set forth herein. The certification test report shall state the lot tested, manufacturer's name, and date of manufacture.

After approval by the Department, samples and certification by the manufacturer shall be submitted for each batch used. The manufacturer shall submit a certification stating that the material meets the requirements as set forth herein and is essentially identical to the material sent for qualification. The certification shall state the lot tested, manufacturer's name, and date of manufacture.

All costs of testing (other than tests conducted by the Department) shall be borne by the manufacturer."

80298

TRAFFIC CONTROL DEVICES - CONES (BDE)

Effective: January 1, 2019

Revise Article 701.15(a) of the Standard Specifications to read:

"(a) Cones. Cones are used to channelize traffic. Cones used to channelize traffic at night shall be reflectorized; however, cones shall not be used in nighttime lane closure tapers or nighttime lane shifts."

Revise Article 1106.02(b) of the Standard Specifications to read:

"(b) Cones. Cones shall be predominantly orange. Cones used at night that are 28 to 36 in. (700 to 900 mm) in height shall have two white circumferential stripes. If non-reflective spaces are left between the stripes, the spaces shall be no more than 2 in. (50mm) in width. Cones used at night that are taller than 36 in. (900 mm) shall have a minimum of two white and two fluorescent orange alternating, circumferential stripes with the top stripe being fluorescent orange. If non-reflective spaces are left between the stripes, the spaces shall be no more than 3 in. (75 mm) in width.

The minimum weights for the various cone heights shall be 4 lb for 18 in. (2 kg for 450 mm), 7 lb for 28 in. (3 kg for 700 mm), and 10 lb for 36 in. (5 kg for 900 mm) with a minimum of 60 percent of the total weight in the base. Cones taller than 36 in. shall be weighted per the manufacturer's specifications such that they are not moved by wind or passing traffic."

80409

WARM MIX ASPHALT (BDE)

Effective: January 1, 2012
Revised: April 1, 2016

Description. This work shall consist of designing, producing and constructing Warm Mix Asphalt (WMA) in lieu of Hot Mix Asphalt (HMA) at the Contractor's option. Work shall be according to Sections 406, 407, 408, 1030, and 1102 of the Standard Specifications, except as modified herein. In addition, any references to HMA in the Standard Specifications, or the special provisions shall be construed to include WMA.

WMA is an asphalt mixture which can be produced at temperatures lower than allowed for HMA utilizing approved WMA technologies. WMA technologies are defined as the use of additives or processes which allow a reduction in the temperatures at which HMA mixes are produced and placed. WMA is produced by the use of additives, a water foaming process, or combination of both. Additives include minerals, chemicals or organics incorporated into the asphalt binder stream in a dedicated delivery system. The process of foaming injects water into the asphalt binder stream, just prior to incorporation of the asphalt binder with the aggregate.

Approved WMA technologies may also be used in HMA provided all the requirements specified herein, with the exception of temperature, are met. However, asphalt mixtures produced at temperatures in excess of 275 °F (135 °C) will not be considered WMA when determining the grade reduction of the virgin asphalt binder grade.

Equipment.

Revise the first paragraph of Article 1102.01 of the Standard Specifications to read:

"**1102.01 Hot-Mix Asphalt Plant.** The hot-mix asphalt (HMA) plant shall be the batch-type, continuous-type, or dryer drum plant. The plants shall be evaluated for prequalification rating and approval to produce HMA according to the current Bureau of Materials and Physical Research Policy Memorandum, "Approval of Hot-Mix Asphalt Plants and Equipment". Once approved, the Contractor shall notify the Bureau of Materials and Physical Research to obtain approval of all plant modifications. The plants shall not be used to produce mixtures concurrently for more than one project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce HMA having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements."

Add the following to Article 1102.01(a) of the Standard Specifications.

"(11) Equipment for Warm Mix Technologies.

a. Foaming. Metering equipment for foamed asphalt shall have an accuracy of ± 2 percent of the actual water metered. The foaming control system shall be electronically interfaced with the asphalt binder meter.

b. Additives. Additives shall be introduced into the plant according to the supplier's recommendations and shall be approved by the Engineer. The system for introducing the WMA additive shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes."

Mix Design Verification.

Add the following to Article 1030.04 of the Standard Specifications.

"(e) Warm Mix Technologies.

(1) Foaming. WMA mix design verification will not be required when foaming technology is used alone (without WMA additives). However, the foaming technology shall only be used on HMA designs previously approved by the Department.

(2) Additives. WMA mix designs utilizing additives shall be submitted to the Engineer for mix design verification."

Construction Requirements.

Revise the second paragraph of Article 406.06(b)(1) of the Standard Specifications to read:

"The HMA shall be delivered at a temperature of 250 to 350 °F (120 to 175 °C). WMA shall be delivered at a minimum temperature of 215 °F (102 °C)."

Basis of Payment.

This work will be paid at the contract unit price bid for the HMA pay items involved. Anti-strip will not be paid for separately, but shall be considered as included in the cost of the work.

80288

WEEKLY DBE TRUCKING REPORTS (BDE)

Effective: June 2, 2012
Revised: April 2, 2015

The Contractor shall submit a weekly report of Disadvantaged Business Enterprise (DBE) trucks hired by the Contractor or subcontractors (i.e. not owned by the Contractor or subcontractors) that are used for DBE goal credit.

The report shall be submitted to the Engineer on Department form "SBE 723" within ten business days following the reporting period. The reporting period shall be Monday through Sunday for each week reportable trucking activities occur.

Any costs associated with providing weekly DBE trucking reports shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

80302

WORK ZONE TRAFFIC CONTROL DEVICES (BDE)

Effective: March 2, 2020

Add the following to Article 701.03 of the Standard Specifications:

"(q) Temporary Sign Supports .....1106.02"

Revise the third paragraph of Article 701.14 of the Standard Specifications to read:

"For temporary sign supports, the Contractor shall provide a FHWA eligibility letter for each device used on the contract. The letter shall provide information for the set-up and use of the device as well as a detailed drawing of the device. The signs shall be supported within 20 degrees of vertical. Weights used to stabilize signs shall be attached to the sign support per the manufacturer's specifications."

Revise the first paragraph of Article 701.15 of the Standard Specifications to read:

"**701.15 Traffic Control Devices.** For devices that must meet crashworthiness standards, the Contractor shall provide a manufacturer's self-certification or a FHWA eligibility letter for each Category 1 device and a FHWA eligibility letter for each Category 2 and Category 3 device used on the contract. The self-certification or letter shall provide information for the set-up and use of the device as well as a detailed drawing of the device."

Revise the first six paragraphs of Article 1106.02 of the Standard Specifications to read:

"**1106.02 Devices.** Work zone traffic control devices and combinations of devices shall meet crashworthiness standards for their respective categories. The categories are as follows.

Category 1 includes small, lightweight, channelizing and delineating devices that have been in common use for many years and are known to be crashworthy by crash testing of similar devices or years of demonstrable safe performance. These include cones, tubular markers, plastic drums, and delineators, with no attachments (e.g. lights). Category 1 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 1 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2024.

Category 2 includes devices that are not expected to produce significant vehicular velocity change but may otherwise be hazardous. These include vertical panels with lights, barricades, temporary sign supports, and Category 1 devices with attachments (e.g. drums with lights). Category 2 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 2 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2024.

Category 3 includes devices that are expected to cause significant velocity changes or other potentially harmful reactions to impacting vehicles. These include crash cushions (impact

attenuators), truck mounted attenuators, and other devices not meeting the definitions of Category 1 or 2. Category 3 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 3 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2029. Category 3 devices shall be crash tested for Test Level 3 or the test level specified.

Category 4 includes portable or trailer-mounted devices such as arrow boards, changeable message signs, temporary traffic signals, and area lighting supports. It is preferable for Category 4 devices manufactured after December 31, 2019 to be MASH-16 compliant; however, there are currently no crash tested devices in this category, so it remains exempt from the NCHRP 350 or MASH compliance requirement.

For each type of device, when no more than one MASH-16 compliant is available, an NCHRP 350 or MASH-2009 compliant device may be used, even if manufactured after December 31, 2019."

Revise Articles 1106.02(g), 1106.02(k), and 1106.02(l) to read:

"(g) Truck Mounted/Trailer Mounted Attenuators. The attenuator shall be approved for use at Test Level 3. Test Level 2 may be used for normal posted speeds less than or equal to 45 mph.

(k) Temporary Water Filled Barrier. The water filled barrier shall be a lightweight plastic shell designed to accept water ballast and be on the Department's qualified product list.

Shop drawings shall be furnished by the manufacturer and shall indicate the deflection of the barrier as determined by acceptance testing; the configuration of the barrier in that test; and the vehicle weight, velocity, and angle of impact of the deflection test. The Engineer shall be provided one copy of the shop drawings.

(l) Movable Traffic Barrier. The movable traffic barrier shall be on the Department's qualified product list.

Shop drawings shall be furnished by the manufacturer and shall indicate the deflection of the barrier as determined by acceptance testing; the configuration of the barrier in that test; and the vehicle weight, velocity, and angle of impact of the deflection test. The Engineer shall be provided one copy of the shop drawings. The barrier shall be capable of being moved on and off the roadway on a daily basis."

80427

WORKING DAYS (BDE)

Effective: January 1, 2002

The Contractor shall complete the work within 40 working days.

80071

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection

for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each

classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term “perform work with its own organization” refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

(1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;

(2) the prime contractor remains responsible for the quality of the work of the leased employees;

(3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and

(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1**. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. **Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of

Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

ATTACHMENT A - EMPLOYMENT AND MATERIALS PREFERENCE FOR APPALACHIAN DEVELOPMENT HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS ROAD CONTRACTS

This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

Contract Provision - Cargo Preference Requirements

In accordance with Title 46 CFR § 381.7 (b), the contractor agrees—

"(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract."

Provisions (1) and (2) apply to materials or equipment that are acquired solely for the project. The two provisions do not apply to goods or materials that come into inventories independent of the project, such as shipments of Portland cement, asphalt cement, or aggregates, when industry suppliers and contractors use these materials to replenish existing inventories.

MINIMUM WAGES FOR FEDERAL AND FEDERALLY ASSISTED CONSTRUCTION CONTRACTS

This project is funded, in part, with Federal-aid funds and, as such, is subject to the provisions of the Davis-Bacon Act of March 3, 1931, as amended (46 Sta. 1494, as amended, 40 U.S.C. 276a) and of other Federal statutes referred to in a 29 CFR Part 1, Appendix A, as well as such additional statutes as may from time to time be enacted containing provisions for the payment of wages determined to be prevailing by the Secretary of Labor in accordance with the Davis-Bacon Act and pursuant to the provisions of 29 CFR Part 1. The prevailing rates and fringe benefits shown in the General Wage Determination Decisions issued by the U.S. Department of Labor shall, in accordance with the provisions of the foregoing statutes, constitute the minimum wages payable on Federal and federally assisted construction projects to laborers and mechanics of the specified classes engaged on contract work of the character and in the localities described therein.

General Wage Determination Decisions, modifications and supersedes decisions thereto are to be used in accordance with the provisions of 29 CFR Parts 1 and 5. Accordingly, the applicable decision, together with any modifications issued, must be made a part of every contract for performance of the described work within the geographic area indicated as required by an applicable DBRA Federal prevailing wage law and 29 CFR Part 5. The wage rates and fringe benefits contained in the General Wage Determination Decision shall be the minimum paid by contractors and subcontractors to laborers and mechanics.