MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
EROSION CONTROL, INLET PROTECTION, FABRIC DROP

COS:DMG 1 of 2 APPR:TWK:CP:03-11-20
FHWA:APPR:03-13-20

a. Description. This work consists of furnishing and installing acceptable alternatives to inlet protection devices (devices) listed in the *Soil Erosion and Sedimentation Control Manual* when the pay item Erosion Control, Inlet Protection, Fabric Drop is included in the contract.

This work consists of furnishing, installing, maintaining, disposing of collected material and removing devices at the locations shown on the plans or as directed by the Engineer.

b. Materials. The following devices are approved for use as acceptable alternatives:

1. Siltsack Type B, Regular Flow, by ACF Environmental, Inc.

2. Inlet Pro Sediment Bag, Standard Flow, with optional foam deflector by Hanes Geo Components.

3. Dandy Curb Bag, Dandy Bag, Dandy Curb Sack, Dandy Sack, or Dandy Pop by Dandy Products, Inc.

4. Basin Bag, Regular Flow by CSI Geoturf.

5. Flexstorm Catch-It and Flexstorm Pure used with filter bag types FX, FX+, FXO, PC, PC+ or IL.

Ensure provided devices are sized appropriately for the drainage structures in which they will be installed.

c. Construction. Install, maintain and remove the devices in accordance with the manufacturer's guidelines. Remove material collected by the devices in accordance with the manufacturer's guidelines or as directed by the Engineer.

Dispose of collected material in accordance with subsection 205.03.P of the Standard Specifications for Construction. Those devices that are no longer needed and have been removed may be reused elsewhere on the project as approved by the Engineer.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Erosion Control, Inlet Protection, Fabric Drop	Each

Erosion Control, Inlet Protection, Fabric Drop will be paid for as one each for each time the alternate device listed herein is installed, maintained, and removed at a separate location within the project limits.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
MAINTENANCE GRAVEL, DRIVEWAY MAINTENANCE, AND INTERSECTION MAINTENANCE MEASUREMENT AND PAYMENT

CFS:MJE 1 of 1 APPR:DMG:LLR:11-17-23
FHWA:APPR:11-21-23

Delete subsections 306.04.B and 306.04.C, on pages 3-24 and 3-25 of the Standard Specifications for Construction, in their entirety and replace with the following:

B. **Maintenance Gravel.** The Engineer will measure **Maintenance Gravel, LM** based on hauling unit dimensions and load count before placement and compaction.

The Engineer will measure **Maintenance Gravel** in tons by the scale weight of the material. The Engineer will perform moisture tests at the start of weighing operations and if construction operations, weather conditions, or other causes may change the moisture content of the material. If tests indicate a moisture content greater than 8%, the Engineer will deduct the weight of the excess moisture from the scale weight of the maintenance gravel until moisture tests indicate the moisture content is no greater than 8%.

The Engineer will determine the moisture content and pay weights as specified in section 109.

The unit price for **Maintenance Gravel** and **Maintenance Gravel, LM** includes the cost of furnishing the aggregate and constructing, maintaining, and removing the aggregate surface.

C. **Driveway Maintenance, Commercial; Driveway Maintenance, Residential** and **Intersection Maintenance** includes material, construction, grading, maintenance, removal, replacement, and disposal of the aggregate surface. These items will be paid for once per location regardless of the number of times the aggregate surface is placed, maintained, removed, or replaced.

Intersection Maintenance will be paid for separately for each approach of the highway, street, or alley that joins or crosses the roadway.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
RECYCLED HOT MIX ASPHALT MIXTURE ON LOCAL AGENCY PROJECTS

CFS:KPK 1 of 2 APPR:JWB:CJB:02-26-20
FHWA:APPR:03-02-20

Add the following subsection to subsection 501.02.A.2 of the Standard Specifications for Construction.

c. **Reclaimed Asphalt Pavement (RAP) and Binder Grade Selection**. The method for determining the binder grade in HMA mixtures incorporating RAP is divided into three categories designated Tier 1, Tier 2 and Tier 3. Each tier has a range of percentages that represent the contribution of the RAP binder toward the total binder, by weight. The tiers identified below apply to HMA mixtures with the following exception: Superpave mixture types EML, EML High Stress, EMH, EMH High Stress, and EH, EH High Stress used as leveling or top course must be limited to a maximum of 27 percent RAP binder by weight of the total binder in the mixture.

Recycled materials may be used as a substitute for a portion of the new materials required to produce HMA mixtures in accordance with contract.

- **Tier 1 (0% to 17% RAP binder by weight of the total binder in the mixture).** No binder grade adjustment is made to compensate for the stiffness of the asphalt binder in RAP.

- **Tier 2 (18% to 27% RAP binder by weight of the total binder in the mixture).** For all mixtures no binder grade change will occur in Tier 2 for all shoulder and temporary road mixtures.

  Ensure the required asphalt binder grade is at least one grade lower for the low temperature than the design binder grade required for the specified project mixture type. Lowering the high temperature of the binder one grade is optional. For example, if the design binder grade for the mixture type is PG 58-22, the required grade for the binder in the HMA mixture containing RAP would be a PG 52-28 or a PG 58-28.

  For Marshall Mixes, no binder grade change will be required when Average Daily Traffic (ADT) is above 7000 or Commercial Average Daily Traffic (CADT) is above 700. No binder grade change will occur for EL mixtures used as leveling or top course.

  The asphalt binder grade can also be selected using a blending chart for high and low temperatures. Supply the blending chart and the RAP test data used in determining the binder selection according to *AASHTO M323*.

- **Tier 3 (≥ 28% RAP binder by weight of the total binder in the mixture).** The binder grade for the asphalt binder is selected using a blending chart for high and low temperatures per *AASHTO M323*. Supply the blending chart and the RAP test data

used in determining the binder selection.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
INSTALLATION, INSPECTION, REPORTING, AND PAYMENT SCHEDULE FOR OVERHEAD SIGN SUPPORTS, TRAFFIC SIGNALS, TOWERS, AND LIGHTING STRUCTURES

a. Description. This special provision sets forth the requirements for installation inspection, reporting, and payment schedule for the following ancillary structures that have anchor bolts pretensioned in accordance with the turn-of-nut method in the Standard Specifications for Construction:

1. Cantilever Sign Support
2. Truss Sign Support
3. Traffic Signal Mast Arm Pole and Mast Arm
4. Dynamic Message Sign (DMS) Support
5. Frangible Light Standards*
6. Non-Frangible Light Standards
7. Tower Lighting Unit
8. Environmental Sensor Station (ESS) Tower

*Note: Frangible Light Standards are included in the requirements set forth by this special provision although they are not pretensioned in accordance with the turn-of-nut method.

b. Inspection. Complete MDOT form 1459 and submit the form and a copy of the applicable plan sheets and shop drawings (attached to the form) to the Engineer requesting installation inspection. The Engineer will have 14 calendar days from receipt of the written request to complete each inspection cycle.

c. Reporting. The Engineer will provide the inspection reports within the 14 calendar day inspection period. The Engineer will review the reports for any nonconformances and ensure any issues noted are corrected in accordance with the contract at no cost to the Department. Once the corrections have been made, notify the Engineer requesting another inspection. An additional 14 calendar day inspection period will be required and repeated until inspection of the item is in conformance with the contract.

d. Measurement and Payment.

1. Initial Disbursement. The Engineer will pay an amount up to 80 percent of the total contract value for all pay items associated with the following items of work once complete:

- Cantilever and cantilever foundation
- Truss and truss foundation
- Traffic signal mast arm pole and mast arm, and traffic signal mast arm pole foundation
- DMS support structure and DMS foundation
- Frangible light standard and frangible light standard foundation
- Non-Frangible light standard and non-frangible light standard foundation
- Tower lighting unit and tower lighting unit foundation
- ESS tower and ESS tower foundation

2. Final Disbursement. Payment of the remaining amounts for the pay items listed above can only be made after the Engineer is satisfied that all corrections have been made in accordance with the contract and all follow-up inspections have been completed. No extension of time and/or additional compensation will be granted to the Contractor for delays resulting from the Contractor's failure to notify the Engineer in writing of the need for inspection, or any delays associated with the specified 14 calendar day inspection periods, unless approved by the Engineer.

3. Contract Price Adjustment for installation inspection, reporting, and payment schedule for overhead sign support structures, traffic signals, and lighting. After the first two inspection cycles, a contract price adjustment will be made for each additional inspection at the rates shown in Table 1. The number of structures is based on the quantity of structures requiring inspection beyond the first two inspections, not the total number of structures in the project.

For example, if from 1 to 10 structures need a third review a total price adjustment of $1,000 would be made. If from 11 to 20 structures need a third review a total price adjustment of $2,000 would be made. Similarly, the same idea works for the number of structures needing a fourth or fifth inspection.

Table 1: Contract Price Adjustment for Additional Inspections

Number of Structures	Contract Price Adjustment
0-10	$1,000
11-20	$2,000
21-30	$3,000
31-40	$4,000
41-50	$5,000
Over 50	$6,000

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
FLEXIBLE DELINEATOR POST INSTALLATION

PMK:MKB 1 of 1 APPR:MWB:AJU:04-10-20
FHWA:APPR:04-13-20

Delete subsections 810.03.B.2 and 810.03.B.3, of the Standard Specifications for Construction in their entirety and replace them with the following:

2. **Installing Flexible Delineator Posts.** Install flexible delineator posts with the required anchoring accessories, in accordance with the post manufacturer's directions. Do not bend or damage the posts. Install the flexible post plumb such that its reflective sheeting will be perpendicular or radial to oncoming traffic. Replace posts or sheeting damaged during installation at no additional cost to the Department.

3. **Reflectors.** Mount reflectors and reflective sheeting as shown on the Standard Plan R-127 Series.

Prior to applying reflective sheeting to flexible delineator posts, the application area of the post must be flame treated. Flame treating may be accomplished with either hand-held torches or commercially available flame treaters, through the following steps:

a. Ensure the area to be flame treated is clean and free of dirt and oils.
b. Adjusted the torch or flame treater to produce a highly oxygenated blue flame. A poorly oxygenated (yellow) flame will not effectively treat the surface.
c. Expose the application area of the post to the blue flame with one-quarter to two inches of separation, moving over the application area at a speed of greater than or equal to one inch per second.
d. Proper distance and duration must be determined for any given substrate or device and should adhere to the post manufacturer’s recommendations. A surface that is properly flame treated will not be exposed to a significant rise in temperature. Improper flame treating operations that overheat the plastic may soften or deform the substrate.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
FLEXIBLE DELINEATORS

PMK:MKB 1 of 2 APPR:AJU:MWB:11-09-23
FHWA APPR:11-20-23

a. Description. This work consists of furnishing and installing rebounding ground-mounted and/or surface-mounted flexible delineators with reflective sheeting in accordance with the standard specifications, the contract, and this special provision.

b. Materials.

1. Ground-Mounted. Select one of the below products or a Department approved equal. Ensure the overall product is impact resistant and capable of returning to its original upright position after being impacted by a vehicle. The anchor system must consist of 2-inch perforated square tubing 24 inches in length that allows for replacement of the post without impacting the anchor.

Shur-Flex Driveable Delineator – Shur-Tite Products
Safe-Hit SQR-LOC Flexible Delineator – Valtir

The selected post must have a height of 48 inches. Ensure the color of the post and the sign sheeting applied to the flexible post are the color of the pavement marking line the delineator is supplementing. Ensure the reflective sheeting is *ASTM Type XI* sheeting with a minimum area of 27 square inches. Sheeting is required on both sides of the post on undivided roadways.

2. Surface-Mounted. Select products from the Qualified Products List (919.03D) with a height as specified in the contract. Ensure the color of the post and the sign sheeting applied to the flexible post are the color of the pavement marking line the delineator is supplementing. Ensure the reflective sheeting has a minimum total area of 27 square inches. Sheeting is required to be visible on all sides of the post that face approaching traffic.

c. Construction. Install flexible delineator posts with the required anchoring accessories, in accordance with section 810 of the Standard Specifications for Construction and the post manufacturer's directions. Do not bend or damage the posts. Install the flexible post plumb such that its reflective sheeting will be perpendicular or radial to oncoming traffic. Replace posts or sheeting damaged during installation at no additional cost to the contract.

Mount reflective sheeting as shown on the Standard Plan R-127 Series.

Prior to applying reflective sheeting to flexible delineator posts, the application area of the post must be flame treated. Flame treating may be accomplished with either hand-held torches or commercially available flame treaters, through the following steps:

1. Ensure the area to be flame treated is clean and free of dirt and oils.

2. Adjust the torch or flame treater to produce a highly oxygenated blue flame. A poorly oxygenated (yellow) flame will not effectively treat the surface.

3. Expose the application area of the post to the blue flame with one-quarter to two inches of separation, moving over the application area at a speed of greater than or equal to one inch per second.

4. Ensure proper distance and duration are determined for any given substrate or device and should adhere to the post manufacturer's recommendations. A surface that is properly flame treated will not be exposed to a significant rise in temperature. Improper flame treating operations that overheat the plastic may soften or deform the substrate.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Post, Flexible, Delineator, Ground Mtd	Each
Post, Flexible, Delineator, Surface Mtd, __ inch	Each

The above pay items include all costs for the post, reflective sheeting, layout, and installation.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TEMPORARY PEDESTRIAN TYPE II BARRICADE

a. Description. This work consists of delivering, installing, maintaining, relocating, and removing a temporary pedestrian Type II barricade section as identified in the proposal or on the plans. Use temporary pedestrian Type II barricades to close non-motorized facilities including sidewalks, bicycle paths, pedestrian paths, and shared use paths that are not part of the roadway. One pedestrian Type II barricade is defined as a barricade section at least 43 inches wide, including all supports, ballast, and hardware.

b. Materials. Provide a temporary pedestrian Type II barricade that meets the requirements of *National Cooperative Highway Research Program Report 350 (NCHRP 350)* or *Manual for Assessing Safety Hardware (MASH)*, in addition to meeting the following requirements:

1. Provide barricade sections at least 43 inches wide, designed to interconnect to ensure a continuous accessible tactile barrier. Ensure the connection includes provisions to accommodate non-linear alignment as well as variations in elevation at the installation area.

2. Ensure the top surface of the barricade is designed to function as a hand-trailing edge and has a height between 32 and 38 inches. Ensure the lower edge of the barricade is no more than 2 inches above the surface of the non-motorized facility. Ensure the top edge of the bottom rail of the barricade is a minimum of 8 inches above the surface of the non-motorized facility. The barricade may have a solid continuous face. Finally, all features on the front face of the barricade (the face in contact with pedestrians) must share a common vertical plane.

3. Equip both sides of the barricade with bands of alternating 6-inch wide orange and white vertical stripes of reflective sheeting. Two bands of sheeting 6 inches tall and a minimum of 36 inches long containing at least two orange and two white stripes each are required. One band placed near the top and one near the bottom if the barricade section has a solid face. If the barricade consists of two rails, affix one band of sheeting to each rail. Ensure the stripes of reflective sheeting are aligned vertically. Ensure this sheeting meets or exceeds the requirements of *ASTM D4956, Type IV* sheeting.

c. Construction. Construct the temporary pedestrian Type II barricade in accordance with the manufacturer's recommendations, MMUTCD, the plans, and the following requirements:

1. Install the barricade as shown on the plans and as directed by the Engineer. Interconnect all barricade sections using hinge components, if necessary, to ensure a continuous detectable edge for the entire installation. Ensure the barricade is ballasted in accordance with the manufacturer's recommendations to ensure stability during wind events and contact with pedestrians.

2. When the barricade is installed near motor vehicle traffic, ensure reflective sheeting is visible to motorists.

3. When temporary pedestrian Type II barricades are used to close a non-motorized facility, ensure a sufficient number of barricade sections are used to block the entire width of the facility. The barricade may extend outside the edge of the non-motorized facility but must not be less than the full width of the facility.

4. If sections of multiple-colored barriers are used (i.e. safety orange and white) install the sections such that the colors alternate to increase conspicuity.

5. Ensure temporary pedestrian Type II barricades are not used to close a motor vehicle facility. Ensure these barricades are not used to guide pedestrian traffic on a motor vehicle facility in the presence of active traffic. This prohibition includes bicycle/shared use lanes or shoulders in the presence of active traffic.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Pedestrian Type II Barricade, Temp	Each

Pedestrian Type II Barricade, Temp, includes delivering, installing, maintaining, relocating, and removing one barricade section that is at least 43 inches wide. Additional payment will not be made if wider sections are provided. Payment will be made on delivery for the quantity delivered to the project site, up to planned quantity. Any amount delivered exceeding plan quantity will not be paid unless approved by the Engineer. This includes all rails, supports, ballast, hinge points, reflective sheeting, and miscellaneous hardware needed to install and maintain a barricade section.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
LANDSCAPE PLANTS SOURCE LIST

RSD:JLB 1 of 1 APPR:MRB:JN:04-09-20
FHWA APPR:04-13-20

a. Description. This work consists of submitting a Landscape Plants Source list to the Engineer at the preconstruction meeting.

b. Materials. Provide a Landscape Plants Source list to the Engineer that identifies each plant by species, size, origin and quantity specified on the project. The list will be reviewed at the preconstruction meeting. Nursery stock must come from nurseries located in Zone 4 or Zone 5 of the 2012 USDA Hardiness Zone Map for landscaping in Michigan's lower peninsula. Nursery stock for landscaping in Michigan's upper peninsula must come from nurseries located in Zone 3 or Zone 4. Nurseries located in Zone 6 of the upper Great Lakes region will be allowed as follows:

1. Located at or north of latitude 40 degrees North.

2. Zone 6b will only include nurseries located in counties that border the Great Lakes.

3. Zone 6 plants will not be accepted for use in the upper peninsula nor in the lower peninsula counties north of US-10 except for those counties bordering Lake Michigan.

Submit requests for plant substitutions to the Engineer at the preconstruction meeting. All substitution requests must be reviewed and approved by the Engineer and Landscape Architect.

c. Construction. None Specified.

d. Measurement and Payment. The completed work, as described, will not be paid for separately, but will be included in the plant material pay items.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
LANDSCAPING

RSD:JN 1 of 1 APPR:NJM:DBP:09-15-22
FHWA:APPR:09-30-22

a. Description. Make the following changes to section 815 of the Standard Specifications for Construction.

Delete subsection 815.03.B, on page 8-135 of the Standard Specifications for Construction, in its entirety and replace with the following:

B. Site Preparation. Excavate holes from the center of staked location, extending a minimum of 1.5 times the diameter of the root ball or bare root unless otherwise approved by the Engineer. Place the root ball on undisturbed soil.

Backfill the planting holes with prepared soil the same day they are dug. After backfilling is complete, place 4 inches of shredded bark mulch unless otherwise shown on plans.

Delete subsection 815.03.F.5, on page 8-137 of the Standard Specifications for Construction, in its entirety.

Delete subsection 815.04.B, on page 8-141 of the Standard Specifications for Construction, in its entirety and replace with the following:

B. Site Preparation. The unit price for **Site Preparation, Max (dollar)** includes the cost of digging holes, providing prepared soil, backfilling holes, disposing of excess excavated material, shredded bark mulch, and bracing and guying.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
DELINEATOR HARDWARE

PMK:MKB 1 of 1 APPR:MWB:DBP:11-09-23
FHWA:APPR:11-20-23

Delete subsection 919.03.C on page 9-163 of the Standard Specifications for Construction in its entirety and replace it with the following:

C. **Mounting Hardware.** Mounting hardware for aluminum reflectors must consist of a bolt system.

Bolts must be stainless steel and accompanied by a locknut to produce a vandal-resistant attachment. A nylon washer is also required to be placed between the bolt head and/or locknut and the face of the reflector to protect the sign sheeting.

Ensure that the system has a large enough diameter that it will not be subject to pulling through the holes in the delineator reflectors or posts.

Alternative fastening systems may be approved by the Engineer provided they form a vandal-resistant attachment.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

PAVT, REM, MODIFIED

Wightman/PAD 1 of 1 08/08/2023

a. Description. This work consists of removing HMA, concrete, bricks and masonry and any other common pavement material or combination of materials, except sand and gravel, regardless of thickness, reinforcement, and overlays.

b. Materials. None Specified

c. Construction Methods. Remove pavement to an existing joint or sawed joint. Saw cut pavement full depth in a straight neat line as directed by the Engineer. Do not use a crane and ball pavement breaker. Do not disturb remaining pavement. Assume ownership of removed materials and dispose of according to subsection 205.03P.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Contract Item (Pay Item)	**Unit**
Pavt, Rem, Modified	Square Yard

The limits of **Pavt, Rem, Modified** will be established as noted on the plans or at the discretion of the Engineer. The unit price includes all labor, equipment, and materials to saw cut, remove, haul and dispose of the pavement.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

MACHINE GRADING, MODIFIED

Wightman/PAD 1 of 1 10/18/2023

a. Description

The work of Machine Grading, Modified will consist of all excavation regardless of depth from the roadbed and all intersecting roadways, and the furnishing and placing of borrow. The CONTRACTOR will conduct their work in such a manner so no excavations are left open overnight. If this is not possible, the CONTRACTOR shall provide and install a temporary fence to protect the excavation at their own expense. Machine Grading, Modified will apply to the sections of this project as shown on the plans where a new pavement section is being constructed. The CONTRACTOR will regrade all drives and intersecting roadways within the ROW or area of designated grading limits to match proposed road elevations, included in the item for Machine Grading, Modified.

b. Construction

Machine Grading, Modified will include all necessary removal regardless of depth, scarifying, plowing, discing, moving, loading, hauling, shaping and compacting the earth to develop the cross section shown on the plans.

Grading will be performed to the bottom of sand subbase grade as shown on the plans.

The roadbed will be finished to grade with a blade grader or equivalent equipment. All intersections, approaches, entrances, and driveways will be graded as shown or as directed as a part of this item. If additional earth is required to complete the full section, the CONTRACTOR will obtain the required Class II materials to be included in the item of Machine Grading, Modified. All excess excavated materials will be disposed of by the CONTRACTOR. The following quantities are provided for informational purposes only.

c. Measurement and Payment

Machine Grading, Modified will be measured along the project centerline and includes both sides of the pavement. No additional measurement will be made for intersecting streets and drives. Machine Grading, Modified will only be measured for payment at locations where shown on the plans. The following quantities are provided for informational purposes only.

Excavation, Earth – 4,750 Cyd (Estimated Qty.)
Embankment, CIP – 3,850 Cyd (Estimated Qty.)

Machine Grading, Modified will be paid for by the station, which price will be payment in full for all work specified herein.

Pay Item	*Pay Unit*
Machine Grading, Modified	Station

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

AGGREGATE BASE, _INCH, MODIFIED

a. Description. This work consists of constructing an aggregate base course on a prepared subbase or subgrade as shown on the plans or as directed by the Engineer. The aggregate base course shall be in accordance with Section 302 and 902 of the Standard Specifications, except as specified herein.

b. Materials. The material for Aggregate Base, _inch, Modified (thickness as specified) shall be MDOT 21AA Gravel.

c. Construction Methods. None Specified.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Contract Item (Pay Item)	**Unit**
Aggregate Base, _ inch, Modified	Square Yard

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

DR STRUCTURE COVER, ADJ, CASE 1, MODIFIED

a. Description. This work consists of removing and replacing existing City of Kalamazoo owned manhole structure covers during HMA surface operations with City of Kalamazoo standard covers. This operation uses the Mr. Manhole™, Manhole Leveling System, or equivalent. Section references are to the current version of the MDOT Standard Specifications for Construction.

b. Materials. Provide materials in accordance with the following:

Cover and Casting: Supply the City of Kalamazoo standard design cover and casting for Sanitary and Storm sewer meeting the requirements of Section 908 and special provision for "Dr Structure Cover, Type _, Modified".

Concrete: Use Grade P-NC concrete meeting the requirements of Section 1006.

Mortar Type R-2: Use mortar meeting the requirement of Section 1005.

HMA: Use HMA mixtures as specified in the special provisions.

c. Construction Methods. Remove existing pavement around the drainage structure using the Mr. Manhole™ or equivalent system. Remove the existing drainage structure in a manner to avoid roadway materials from entering the manhole structure. Salvage existing manhole covers and castings if in good condition; otherwise replace the casting and cover. If pickup is needed, notify the Engineer when manhole cover and casting are ready for pickup. Place a steel plate over the manhole structure and fill in the resulting void with the HMA mixture or material approved by the Engineer. Record the location of each structure and use a locating system or GPS record of each structure for finding it following final paving.

Prior to paving, ensure that locations of structures are confirmed & recorded, and any markers or caps used are in place to easily identify and find each structure after final paving. Upon completion of final paving, cut out and remove the pavement around the structure using the Mr. Manhole™ or equivalent system. Avoid roadway materials from entering the manhole structure. Remove the plate and locator cap. Set the new structure cover in a full bed of mortar or using custom adjusting rings built for this purpose. Adjust in accordance with manufacturer's instructions, MDOT Standard Specifications, and best practices. Set the structure cover level with the roadway (nominal offset = 0", maximum offset = +/- 1/8"). Fill in resulting void with concrete meeting the requirements of Section 1006. Assume ownership of excess removed materials and dispose of according to subsection 205.03P.

Any material entering the Sewer system must be removed promptly. If the contractor neglects to remove the material within 7 days for storm or 24 hours for sanitary after receiving written notification from the Engineer, the Engineer may proceed with the removal. The Engineer will deduct the cost of the removal from the monies that are or may become due to the contractor.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Contract Item (Pay Item)	Unit
Dr Structure Cover, Adj, Case 1, Modified	Each

The unit price for **Dr Structure Cover, Adj, Case 1, Modified** includes all labor, equipment, and material to remove the existing pavement, install the new cover and casting, and place the concrete collar.

CITY OF KALAMAZOO

<u>SPECIAL PROVISION</u>

FOR

DR STRUCTURE COVER, TYPE __, MODIFIED

Wightman/PAD 1 of 1 08/09/2023

a. Description. This work consists of furnishing, placing and adjusting to final grade City of Kalamazoo owned sanitary and storm sewer structure covers during construction operations in accordance with Section 403 of the 2020 MDOT Standard Specifications for Construction.

b. Materials. Provide materials in accordance with the following:

<u>Cover and Casting:</u> Supply a Dr Structure Cover, Type __, Modified in accordance with City of Kalamazoo Specifications for Sanitary and Storm sewer meeting the requirements of Section 908 of the MDOT Standard Specifications for Construction.

Cover B (Storm Sewer) - shall consist of an EJIW 1045ZPT (bolted) frame with a 1040A (non-bolted) ***Non-Vented*** Cover with 2 inch "STORM SEWER" lettering or approved equal.

Cover Q (Sanitary Sewer) – shall consist of an EJIW 1045ZPT (bolted) frame with a 1040A (non-vented) Cover with 2 inch "SANITARY SEWER" lettering or approved equal.

c. Construction Methods. See the special provision for "Dr Structure Cover, Adj, Case 1, Modified for construction methods.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Contract Item (Pay Item)	**Unit**
Dr Structure Cover, Type __, Modified	Each

The unit price for **Dr Structure Cover, Type __, Modified** includes supplying the new cover and adjustment rings to be placed and adjusted per the special provision for "Dr Structure Cover, Adj, Case 1, Modified.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

HMA APPLICATION ESTIMATE

Wightman/PAD 11/29/2022

a. Description. This work shall be done in accordance with Division 5 of the 2020 MDOT Standard Specifications for Construction except as herein specified. The Local Agency representative will perform density testing.

b. Materials. The HMA application estimate is as follows:

T-1. HMA, 5EML (TOP) shall have a yield of 165 pounds per square yard, AWI shall be 260-min.
L-1. HMA, 4EML (LEVELING) shall have a yield of 220 pounds per square yard
B-1. HMA, 3EML (BASE) shall have a yield of 330 pounds per square yard
T-2. HMA, 4EML (TOP) shall have a yield of 220 pounds per square yard, AWI shall be 260-min
L-2. HMA, 3EML (LEVELING) shall have a yield of 330 pounds per square yard

Asphalt binder shall be PG 64-28 for all mix designs.

HMA, Approach shall be HMA, 4EML (leveling) applied at 165 or 220 pounds per square yard and HMA, 5EML (top) applied at 165 pounds per square yard with an AWI of 260 or other mix as approved by the Engineer in writing prior to placement.

Hand Patching shall be HMA, 5EML or other mix as approved by the Engineer in writing before placement. The maximum application rate for 5EML is 220 pounds per square yard. Install Hand Patching in multiple lifts if necessary.

Target air voids shall be designed for 4.0% and field regressed to 3.0% for all HMA mixes.

Aggregate Wear Index for the HMA, 5EML (Top) shall be 260 minimum.

HMA Bond Coat shall be type SS – 1h and be applied at the rate of 0.05 to 0.15 gal/syd per manufacturer's recommendation.

RAP shall not exceed Tier 1 limits as specified in the *MDOT Special Provision for Recycled Hot Mix Asphalt Mixture on Local Agency Projects* included in this proposal.

c. Construction Methods. Construction of HMA pavements, shoulders, and approaches shall be in accordance with Subsection 501.03 of the 2020 MDOT Standard Specifications for Construction. Tapered overlapping longitudinal joints will not be allowed in the top course of the HMA surface. Tapered overlapping longitudinal joints are restricted to base and leveling courses only. Joints in the various courses shall be staggered by a minimum of 6 inches with the joints in the top course placed immediately adjacent to the proposed lane lines.

d. Measurement and Payment. Measurement and payment shall be at the contract unit price per ton.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

DECORATIVE CONCRETE PAVEMENT

a. Description. This work consists of constructing **herringbone** pattern stamped decorative Portland cement concrete pavement at the locations specified on the plans. Complete this work in accordance with the standard specifications, except as modified herein.

b. Submittals. Submit a plan showing the types and locations of joints, reinforcement, and sequence of construction. Submit a report detailing the concrete mix designs to be used, including manufacturers and/or suppliers of mixture components. Submit technical data sheets for a single manufacturer's complete system for products and/or materials including admixtures, colorants, curing compounds, decorative concrete sealer, dry-shake finish materials, imprinting tools, and any other products requested by the Engineer. Submit Test Data Certification with test results conducted by an independent testing laboratory within the past 24 months reporting that the coloring pigment conforms to the general requirements of *ASTM C979/C979M*. Obtain approval from the Engineer prior to beginning work.

c. Certification. Provide proof of MCA Decorative Concrete Certification or proven equivalent manufacturer training and certification for placing decorative concrete, to the Engineer.

d. Materials. Use a single manufacturer's complete system for products and/or materials.

1. Concrete Colorant. Use complete pigment system including integral colorants, dry shake colorants, and/or release hardeners from one of the following manufacturers, or other sources as approved by the Engineer.

Brickform	989-792-9009
Decorative Concrete Resources	866-792-9000
Increte Systems	800-752-4626
L.M. Scofield Co.	586-292-1492
Prism Pigments	888-440-4250
Proline Concrete Tools	800-795-4750

A. Concrete Integral Color. Use Brickform Signature Integral Color: Red Barn, #P1840 pre-weighed and packaged coloring pigment in either powder, granular, or liquid form. Ensure that materials comply with *ASTM C979/C979M* standards for integrally colored concrete.

B. Release Agent. Use Brickform Standard Color: Dark Gray, #100 dry-shake powder to facilitate release of imprinting tools as manufactured by Brickform, Prism Pigments, or approved equal.

2. Curing Compound. Do not use standard curing compounds on decorative concrete. Instead use a surface sealer as listed in subsection d.3 of this special provision.

3. Surface Sealer. Use a Type I, Class A solvent acrylic sealer in accordance with the requirements of *ASTM C1315* from the approved list below, or other as approved by the Engineer.

A. Brickform.

- Safety-Seal MS-5.

B. ChemMasters.

- Certi-Vex AC 1315 solvent base sealer.

4. Slip resistant additive. Mix slip resistant additive with the sealer in accordance with the manufacturer's recommendations.

A. Increte.

- Shur-Grip.

B. ChemMasters.

- Slip Stop.

C. H & C.

- SharkGrip.

e. Equipment. To impart desired texture, use high-quality resilient mats reproduced from castings of natural materials and providing uniform control of joint depth. Use tools capable of producing the pattern(s) shown on the plans and/or as required by the Engineer. Use imprinting tool(s) from the approved manufacturer and pattern list below, or present a substitute mat design, manufacturer, or pattern to the Engineer for approval:

Concrete Stamp. Concrete Stamp to be Brickform Herringbone Used Brick, FM-500 s/o, 25.25" x 36.5", or approved equal. Stamp described as A weatherworn brick surface with an uneven texture and rounded broken edges. Matching skin / touch-up wheel: Used Brick / FM-6540. Joint size 1/4″ – 1/2″ wide, 1/4″ deep. Stone size 3 3/4″ wide, 7 1/2″ long

f. Field-Constructed Mock-up. Prior to installation of colored concrete and/or stamped concrete paving work, construct mock-up panels in place to verify color and texture selections and processes for qualities of appearance, materials, and construction. Build mock-ups to comply with the following requirements:

1. Size. Cast a minimum 8 foot by 8 foot mock-up to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

2. Acceptance. If Engineer determines that mock-up does not meet requirements, demolish, and remove it from the site, and cast another until the mock-up is accepted. All costs associated with mock-ups in addition to the first will be borne by the Contractor.

3. Use. Keep accepted mock-up undisturbed during construction as a standard for comparison to completed paving. Undamaged mock-up may be incorporated into the work or demolished and removed from the site when directed by the Engineer.

g. Construction. Construct pavement in accordance with section 602 of the Standard

Specifications for Construction.

1. Preparation. Carefully lay out the locations of forms and joints, taking into consideration the orientation of the pattern as shown on the plans, intended aesthetics, and construction sequence.

2. Integral Color. Comply with the color manufacturer's published recommendations and instructions for mix designs, admixtures, concrete temperature, mixing, installing, finishing, and curing. Coordinate stamped colored concrete to ensure consistency in color, texture, and quality.

3. Release Agent. Apply powder release agent per manufacturer guidelines at the minimum rate required to cover the previously colored surface. “Liquid Antique” agent can be used as a substitute for the dry release agent. If clear liquid release agent is to be used, apply per manufacturer guidelines. Colored powder release agent can be mixed with clear liquid and sprayed on the surface only after the imprinting has been completed, to create an accent coloring.

4. Imprint Pattern. Comply with tool manufacturer's standards and MCA practices. Lay out to proper alignment and imprint to a consistent depth while concrete is plastic. Do not allow the surface to crust over or harden before stamping. Hand-tool in areas where using imprinting tools is not practical.

5. Removal of Excess Release Agent. Wash off excess release agent with normal water pressure prior to joints being cut. Remove a minimum of 80 percent of the release agent. Temperature conditions will dictate the timing of release agent removal. Dispose of any excess release agent in compliance with local regulations.

Acid washing of decorative surface may be required to achieve the desired finish as directed by the Engineer. A minimum of 36 hours after placement, apply a solution of 1 part muriatic acid to 30 parts potable water to the surface of the pavement and lightly scrub with a straw broom. Wash the surface until proper color has been achieved and then flush thoroughly.

6. Sealing Decorative Surface. Seal the surface with approved sealer in accordance with the manufacturer’s recommendations. Refer to subsection d.3. of this special provision for approved products and to the manufacturer’s technical data sheets for proper installation procedures, including moisture content restrictions at time of application.

h. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Conc Pavt, Decorative, Nonreinf, 4 inch	Square Yard

Conc Pavt, Decorative, Nonreinf, 4 inch includes coloring, mixing, hauling, placement, strikeoff, finishing, texturing, stamping, curing [and jointing]. **Conc Pavt, Decorative, Nonreinf, 4 inch** will be measured and paid for by area in square yards based on plan quantities.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

Perimeter Lit Type III Signs

a. Description. This work consists of furnishing and installing a permanently powered perimeter lit sign in accordance with Sections 810 and 820 of the 2020 MDOT Standard Specifications for Construction and as modified herein.

As applicable, this work includes installation of the sign, radio, antenna, control box, mounting hardware, push-button activation and all associated material required to complete the work.

b. Materials. Provide materials in accordance with sections 918, 919, and 921 of the Standard Specifications for Construction and the following requirements of this special provision:

1. LED Perimeter Sign. Provide an LED Perimeter Sign meeting the following requirements:

A. Furnish a Type IIIA sign, with the indicated legend, in accordance with Section 810 of the Standard Specifications for Construction and the MMUTCD.

B. Furnish a solid-state controller which is user programmable and provides an MMUTCD compliant flash pattern. Include the necessary provisions to operate the controller and LED sign from a permanent 120 vac source.

C. Provide a NEMA 4X rated housing for all components

D. LED lighting shall be High Power Luxeon 1-Watt with 100,000 hour life expectancy and shall be amber in color.

E. Base sign shall be yellow-green in color

F. 900 Mhz radios capable of synchronizing activation across all perimeter lit signs at the cross-walk.

G. Perimeter Lit Sign shall be a Blinkersign by Tapco, Trafficcalm Basic Flashing Sign System by Trafficcalm, or approved equal.

c. Construction. Complete this work in accordance with sections 819, 820, and 919 of the Standard Specifications for Construction, per the plans, and this special provision.

1. Sign legend shall be as specified on the plans in accordance with the MMUTCD.

2. Mount the Perimeter Lit Sign to the support as indicated on the plans using *AISI 300* series stainless steel hardware and in accordance with manufacturer recommendations.

3. Configure operation as directed by the Engineer

4. Furnish all warranty and instructional documentation and conduct training on operation and maintenance with City Staff.

5. Obtain shop drawing approval from the Engineer prior to installation of units.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Sign, Type III, Perimeter Lighted, (Sign Legend) (LED)	Each

The unit price for Sign, Type III, Perimeter Lighted, (Sign Legend) (LED) includes furnishing, installing, and configuring the specified illuminated sign, controller. Electrical service, post, pushbutton, foundation, and additional signs shall be paid separately.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

WATERBORNE PERMANENT PAVEMENT MARKINGS

Wightman/PAD 10/26/2023

a. Description

This work consists of providing all labor, material, and equipment necessary to prepare pavement surfaces and apply retroreflective permanent waterborne pavement markings. Ensure preparation of pavement surfaces and application of materials is in accordance with this special provision, the contract, 2020 MDOT Standard Specifications for Construction, Michigan Manual on Uniform Traffic Control Devices, manufacturer's recommendations, and as directed by the Engineer.

b. Material

Provide material for waterborne pavement markings and glass beads in accordance with section 920 of the 2020 MDOT Standard specifications for Construction and from the Qualified Product List.

c. Construction

Install retroreflective permanent waterborne pavement markings of the type indicated at the specified locations or at the direction of the Engineer in accordance with section 811 of the 2020 MDOT Standard specifications for construction. Legends and symbols shall be of the appropriate shape and dimensions as provided for in the most recent edition of the Michigan Manual on Uniform Traffic Control Devices.

d. Measurement and Payment

The completed work as described will be measured and paid for at the contract price using the following pay items:

Pay Item	*Pay Unit*
Pavt Mrkg, Waterborne, __ inch, (type)	Foot
Pavt Mrkg, Waterborne, (legend/symbol)	Each
Pavt Mrkg, Waterborne, __ inch, Cross Hatching, (color)	Foot
Pavt Mrkg, Waterborne, __ inch, Dotted Thru Guide Line, (color)	Foot
Pavt Mrkg, Waterborne, __ inch, Solid Turning Guideline, (color)	Foot

Removing curing compound, removing existing pavement marking, or recessing pavement markings required for the work in this special provision will be paid for separately under the respective pay items.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

GREEN PAVEMENT MARKINGS

a. Description. This work shall consist of installing green pavements markings across intersections to delineate and bring attention to non-motorized facilities.

b. Materials. Green colored pavement markings shall comply with FHWA Interim Approval 14 and the design of green colored pavements therein. Markings applied to the roadway should be of materials that will minimize loss of traction for bicyclists (see Paragraph 4 of Section 3A.04 of the 2009 MUTCD).

c. Construction. Before applying green pavement markings, ensure the pavement is swept and free of dirt and debris, is clean and dry, and pavement temperature is 40 degrees (F) and rising. Ensure that templates match MDOT approved sizes and standards or have had Engineer approval before use. Retroreflective beads/paint should be used at the application rate specified for the type of pavement marking being painted or as approved by the Engineer. At the discretion of the Engineer, where present pavement markings exist for crosswalks, place green pavement markings between or next to existing markings without obliterating the existing markings.

d. Measurement and Payment. The completed work as measured for Green Pavement Markings will be paid for at the following contract item (pay item). The price shall be payment in full for furnishing all necessary labor, equipment, and materials.

Pay Item	**Pay Unit**
Pavt Mrkg, 24in Crosswalk, Special	FT

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **INFORMATION**: MUTCD – Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14)

Date: APR 15 2011

From: Jeffrey A. Lindley
Associate Administrator for Operations

In Reply Refer To: HOTO-1

To: Federal Lands Highway Division Engineers
Division Administrators

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the application or manner of use of an existing traffic control device, or a provision not specifically described in the Manual on Uniform Traffic Control Devices (MUTCD).

Background: Chapter 3G of the 2009 MUTCD contains provisions regarding the use of colored pavements. Paragraph 1 of Section 3G.01 describes colored pavement as consisting of differently colored road paving materials, such as colored asphalt or concrete, or paint or other marking materials applied to the surface of a road or island to simulate a colored pavement.

If colored pavement is used to regulate, warn, or guide traffic, the colored pavement is considered to be a traffic control device. Paragraph 3 of Section 3G.01 limits the use of colored pavement used as a traffic control device to the colors yellow and white. Paragraph 2 of Section 3G.01 discusses the use of colored pavement as a purely aesthetic treatment that is not intended to regulate, warn, or guide traffic and is therefore not considered to be a traffic control device. Part 9, Traffic Control for Bicycle Facilities, of the 2009 MUTCD does not mention colored pavement.

A number of experiments have been conducted in the United States and in other countries around the world to determine the value of designating a particular pavement color to communicate to road users that a portion of the roadway has been set aside for exclusive or preferential use by bicyclists and to enhance the conspicuity of a bicycle lane or a bicycle lane extension. Green, blue, and red are among the colors that have been tested for this purpose. Because these colored pavements are intended to regulate, warn, or guide traffic (motorists and bicyclists) and thus are serving as more than just an aesthetic treatment, they are considered to be traffic control devices.

For the past 10 years in the United States, green has been the only color that has received official FHWA approval for colored pavement experiments on bicycle facilities. Blue colored pavement cannot be designated for exclusive or preferential use in bicycle facilities because it is already the primary color of the international symbol of accessibility parking symbol (see Figure 3B-22 of the 2009 MUTCD) and it is also used for the lines that are adjacent to parking spaces that are reserved for use only by persons with disabilities. The use of red colored pavement has not been approved for any bicycle-related experiments in the United States because it is currently being tested for a different potential use.

Research on Green Colored Pavement for Bike Lanes: Agencies across the United States are showing an increased interest in using colored pavement specifically for bicycle facilities, and many of them have submitted requests to the FHWA to experiment with colored pavement. During the past 10 years, the FHWA has approved experiments with green colored pavement for a variety of State and local governmental agencies, including the following: the Vermont Agency of Transportation; the City of Chicago, IL; the City of New York, NY; the City of St. Petersburg, FL; the City of San Francisco, CA; the City of Portland, OR; the City of Columbia, MO; the City of Long Beach, CA; the City of Austin, TX; the City of Nashville, TN; the City of Missoula, MT; the City of Golden, CO; the Minnesota DOT (for Minneapolis); and the Pennsylvania DOT (for Philadelphia). In these experiments, green colored pavement is being used as a traffic control device to designate locations where bicyclists are expected to operate, and areas where bicyclists and other roadway traffic might have potentially conflicting weaving or crossing movements.

FHWA Evaluation of Results: The Office of Transportation Operations has reviewed the available data and considers the experimental green colored pavement to be satisfactorily successful for the bicycle applications that were tested. Positive operational effects have been noted in the experiments, such as bicyclists positioning themselves more accurately as they travel across intersections and through conflict areas, and no notable negative operational effects have been observed. The research has also shown that bicyclists and motorists both have a positive impression of the effect of the green colored pavement, with bicyclists saying that they feel safer when the green colored pavement is present, and motorists saying that the green colored pavement gives them an increased awareness that bicyclists might be present and where those bicyclists are likely to be positioned within the traveled way.

The design of the experimental green colored pavement is not proprietary and can be used by any jurisdiction that requests and obtains interim approval from the FHWA to use green colored pavement. The FHWA believes that the experimental green colored pavement has a low risk of safety or operational concerns.

This Interim Approval does not create a new mandate compelling the use of green colored pavement, but will allow agencies to install green colored pavement, pending official MUTCD rulemaking, to enhance the conspicuity of a bicycle lane or a bicycle lane extension.

Conditions of Interim Approval: The FHWA will grant Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and traffic conflict areas to any jurisdiction that submits a written request to the Office of Transportation Operations. A State may request Interim

Approval for all jurisdictions in that State. Jurisdictions using green colored pavement under this Interim Approval must agree to comply with the technical conditions detailed below, to maintain an inventory list of all locations where green colored pavement is installed, and to comply with Item D in Paragraph 18 of Section 1A.10 of the 2009 MUTCD, which requires:

> "An agreement to restore the site(s) of the Interim Approval to a condition that complies with the provisions in this Manual within 3 months following the issuance of a Final Rule on this traffic control device; and terminate use of the device or application installed under the interim approval at any time that it determines significant safety concerns are directly or indirectly attributable to the device or application. The FHWA's Office of Transportation Operations has the right to terminate the interim approval at any time if there is an indication of safety concerns."

1. General Conditions:

   The use of green colored pavement is optional. However, if an agency opts to use green colored pavement under this Interim Approval, the following design and installation requirements shall apply, and shall take precedence over any conflicting provisions of the MUTCD.

2. Allowable Uses:

   Green colored pavement may be used within a bicycle lane or within an extension of a bicycle lane to enhance the conspicuity of the bicycle lane or extension.

   The use of green colored pavement under this Interim Approval is limited to the following applications:

   a. Green colored pavement may be installed within bicycle lanes as a supplement to the other pavement markings that are required for the designation of a bicycle lane. Green colored pavement shall not be used instead of the longitudinal line required by Paragraph 2 of Section 9C.04 of the 2009 MUTCD or instead of the word, symbol, and arrow pavement markings illustrated in Figure 9C-3 of the 2009 MUTCD and required by Item C in Paragraph 6 of Section 3D.01 of the 2009 MUTCD. The green colored pavement may be installed for the entire length of the bicycle lane or for only a portion (or portions) of the bicycle lane. Green colored pavement may be installed as a rectangular background behind the word, symbol, and arrow pavement markings in a bicycle lane as a means of enhancing the conspicuity of these word, symbol, and arrow pavement markings.

   b. If a pair of dotted lines is used to extend a bicycle lane across an intersection or driveway (see Section 3B.08 of the 2009 MUTCD) or a ramp, green colored pavement may be installed between these lines as a supplement to the lines. Green colored pavement shall not be used instead of these dotted lines to extend a bicycle lane across an intersection, driveway, or ramp. The green colored pavement may be installed for the entire length of the bicycle lane extension or for only a portion (or portions) of the bicycle lane extension. The pattern of the green colored pavement may be dotted in a manner that matches the pattern of the

dotted lines, thus filling in only the areas that are directly between a pair of dotted line segments that are on opposite sides of the bicycle lane extension.

c. If a pair of dotted lines is used to extend a bicycle lane across the beginning of a turn bay where drivers who desire to turn must cross the bicycle lane when moving out of the through lane in order to turn (see Figures 9C-1, 9C-4, and 9C-5 of the 2009 MUTCD), green colored pavement may be installed between these lines as a supplement to the lines. Green colored pavement shall not be used instead of these dotted lines to extend a bicycle lane across the beginning of a turn bay. The green colored pavement may be installed for the entire length of the bicycle lane extension or for only a portion (or portions) of the bicycle lane extension. The pattern of the green colored pavement may be dotted in a manner that matches the pattern of the dotted lines, thus filling in only the areas that are directly between a pair of dotted line segments that are on opposite sides of the bicycle lane extension.

3. Design of Green Colored Pavement:

a. The daytime chromaticity coordinates for the color used for green colored pavement shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.266	0.500	0.367	0.500	0.444	0.555

The daytime luminance factor (Y) shall be at least 7, but no more than 35.

b. The nighttime chromaticity coordinates for the color used for green colored pavement shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.336	0.540	0.450	0.500	0.479	0.520

c. Green colored pavement may be retroreflective, but there is no requirement or recommendation that it be retroreflective.

d. If green paint or other marking materials applied to the roadway surface are used to simulate a green colored pavement, consideration should be given to selecting pavement marking materials that will minimize loss of traction for bicyclists (see Paragraph 4 of Section 3A.04 of the 2009 MUTCD).

4. Other:

Except as otherwise provided above, all other provisions of the MUTCD that are applicable to colored pavements shall apply to green colored pavement.

Any questions concerning this Interim Approval should be directed to Mr. Bruce Friedman at bruce.friedman@dot.gov.

cc:
Associate Administrators
Chief Counsel
Chief Financial Officer
Directors of Field Services
Director of Technical Services

CITY OF KALAMAZOO

<u>SPECIAL PROVISION</u>

FOR

CONDUIT, __INCH, INNERDUCT

Wightman/PAD 11/30/2023

a. Description

This work shall include all labor, materials and equipment necessary to install the conduit of the diameter specified as shown on the plans, inside an existing conduit, as directed by the Engineer in the field, and as specified herein. All work shall be coordinated with the contact shown on the plans for each utility, or their designated representative. All work shall be performed in accordance with Section 818 of the MDOT 2020 Standard Specifications for Construction and as specified herein.

b. Materials

All pipe materials shall be schedule 40 PVC conduit, with a nylon cord line, minimum 1/8" diameter, to allow a cable pulling rope to be pulled through the duct. Conduit materials shall meet the requirements of section 918 of the MDOT 2020 Standard Specifications for Construction. All ends of conduit must be sealed and marked. All conduit interiors shall be clean and dry upon completion.

c. Construction

The conduits shall be installed in accordance with Section 819 of the 2012 Standard Specifications for Construction. All conduits shall be installed inside existing conduits as shown on the plans or as directed by the Engineer.

d. Measurement and Payment

The Contractor will be paid the unit price bid for each foot of the conduit actually installed and will be payment in full for all labor, materials, and equipment required for complete installation.

<u>Pay Item</u>	*<u>Pay Unit</u>*
Conduit, 1 ¼ inch, Innerduct	Foot

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

CONDUIT, DB, 1, 2 INCH

Wightman/PAD 1 of 1 11/29/2023

a. Description. This work consists of furnishing and installing direct burial conduit in accordance with section 818 and 918 of the 2020 MDOT Standard Specifications for constructions and as modified herein.

b. Materials. Conduit and fittings shall be schedule 40 PVC in accordance with subsection 918.01 of the 2020 MDOT Standard Specifications for Construction.

c. Construction Methods. Install conduit in accordance with subsection 818.03.A of the 2020 MDOT Standard Specifications for Construction.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Contract Item (Pay Item)	**Unit**
Conduit, DB, 1, 2 inch	Foot

The unit price for Conduit, DB, 1, 2 inch includes the cost of installing the conduit shown on the plans and marking tape.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

CONNECT TO EXISTING MAIN, _ INCH

a. Description

For the unit prices bid for the various connections to existing mains as defined below under the heading "Measurement and Payment", the CONTRACTOR shall do all work necessary to connect the proposed mains to the existing mains as shown on the plans and as herein specified.

Scope

1. This Section includes installing water main systems.

2. Reconnection of proposed water main and/or water service connections to existing water main and/or water service constructions shall be in conformance with requirements of this Section.

3. This Section shall include excavating, installing, testing, disinfecting, and backfilling all required water main pipe, water service pipes, water main appurtenances, water service, and other work incidental to the water main and/or water service installation unless specifically included under other Items.

4. This work shall also consist of providing as-constructed plans of the completed work as detailed in the special provision for Water Main and Fittings.

5. Minimum 72 hour advance notice to the City's Project Manager is required prior to connecting to existing water mains or existing services larger than 2-inch.

Work Included Under Other Contract Items

Water Main and Fittings
Valves and Boxes
Fire Hydrants
Hydrant, Rem
Water Services

b. Materials

Provide materials in accordance with section 823 of the MDOT Standard Specifications for Construction and the Special Provision for Water Main and Fittings.

c. Construction

The work under the various connection items shall include all work required to connect the proposed main to the existing main (ductile iron, cast iron, or plastic) as shown on the plans. Included shall be removing any existing plugs or fittings, furnishing and installing any required fittings, including but not limited to cut-in-tees, cut-in-sleeves, and any other work and materials required to switch over to the new main. The installation of all valves and fittings other than those required to connect to the existing main shall be paid for under their respective bid items.

The existing and required fittings shown on the plans are based upon available information. The CONTRACTOR shall expose the existing main and fittings at the proposed connection and shall determine the actual fittings required. The CONTRACTOR shall be responsible with the aid of the OWNER and the ENGINEER for determining the location of any existing valves necessary to isolate and shut down the existing main for the connections. The CONTRACTOR shall have all required fittings and equipment ready for installation prior to shutting off the existing main to minimize the shut down period in accordance with the "Water Main and Fittings" specification. The CONTRACTOR shall coordinate with the Department of Public Services and the Engineer to determine the timing for the connections.

Do not disturb or cut into existing in-service water mains. If the operation of valves on existing watermains is required, notify the City of Kalamazoo a minimum of 3 working days in advance. Contractor shall not operate existing valves without the City's Project Manager's approval. Coordinate scheduling of water main connections with the City of Kalamazoo. Secure the Engineer or authorized representative's approval of the schedule before beginning the work. Connections to existing water mains shall be performed between 8:00 AM and 4:00 PM Monday through Friday. Water shall be turned on by 4:00 PM on the day of the connection.

1. The plans show the locations of existing utilities in accordance with available data. If the work requires precise information on the location of existing utilities, the Contractor shall expose existing utilities to determine the actual locations.

2. Do not disturb or cut into existing in-service water mains. If the operation of valves in existing water mains is required, notify the City of Kalamazoo a minimum of 3 working days in advance. Coordinate scheduling of water main connections with the City of Kalamazoo. Secure the City's Project Manager's approval of the schedule before beginning the work.

3. The City of Kalamazoo will open or close in service valves and provide on-site inspections for all water main and water service installations, unless directed otherwise by the City's Project Manager.

4. Minimize the out of service time for existing water mains to a maximum of 4 hours. Minimize interference with the water supply if abandoning existing water mains and incorporating new water mains into the water system.

5. Disinfect all pipe and fittings with 1% chlorine solution prior to installation.

6. If required and directed by the City, installation of one corporation stop and copper tubing to facilitate flushing and sampling when placing the water main back into service. Upon receipt of acceptable sample results, the copper tubing shall be removed and a copper disc shall be installed in the corporation stop.

d. Measurement and Payment

The CONTRACTOR will be paid his unit price for each proposed water main connected to existing water main, regardless of main material, as shown on the plans.

The Contract Items included under this category of "Connection to Existing Mains", are defined as follows:

Pay Item	*Pay Unit*
Connect to Existing Main, 8 inch	Each
Connect to Existing Main, 6 inch	Each
Connect to Existing Main, 4 inch	Each

The item for **Connect to Existing Main, __ inch** shall include furnishing and installing caps, plugs, fittings, sleeves and mechanical joints required to connect the proposed main to the existing main. It also includes all labor, equipment and materials required to connect the proposed main to the existing main and any excavation, dewatering, backfill, compaction and testing required to complete work as described herein.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

GATE BOX, ADJUST, CASE 1, MODIFIED

Wightman/PAD 1 of 1 10/27/2023

a. Description

This work consists of adjusting gate boxes in accordance with Subsection 403.03C and 823.03 of the 2020 MDOT Standard Specifications for Construction.

b. Materials

Use MDOT P-NC Concrete with no fly ash and coarse aggregate 6AA meeting the requirements of section 1006.

c. Construction

Adjust gate box according to subsection 823.03 and place a concrete collar around the adjusted structure. The concrete shall be uniformly placed around the valve box to a depth specified by the Engineer with the top of the concrete flush with the top of the final course of HMA. Concrete collar thickness shall be 6-inches minimum.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Gate Box, Adjust, Case 1, Modified	Each

The Unit price for Gate Box, Adjust, Case 1, Modified Refers to structures located in hard surfaced travel areas, and the unit price includes saw cutting using the Mr. Manhole Method or other City approved method; removing and replacing existing pavement, curb, or curb and gutter; adjusting the water shutoff or gate box to final grade, and placing the concrete collar.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

GATE BOX, RECONSTRUCT, MODIFIED

a. Description

This work consists of furnishing and placing a gate box centered, plumbed, and adjusted to the required pavement grade over the existing gate valve.

b. Materials

Valve boxes and vaults shall be supplied new by the Contractor. No second hand or salvaged material shall be allowed or supplied. All supplied products shall be **"Buy American"** unless otherwise specified and comply with the conditions of this section.

Valve Boxes and Vaults

Gate Valve Box or 2 inch Service Box – the valve box shall be of adjustable length screw type for 5-foot depth of cover. The valve box shall be a malleable iron casting conforming to subsection 908.03 of the 2020 Michigan Department of Transportation Standard Specifications for Construction. This valve box shall either be a two or three piece screw type and the cover shall be inscribed with the word "water." Valve box 8550 Series (two piece) or 8560 Series (three piece) manufactured by EJ, 4905 size no. 22 manufactured by Bingham & Taylor, or approved equal.

Gate Valve Box extensions shall be cast iron and manufactured by EJ or Bingham & Taylor, capable of being mounted directly to the gate valve box.

Concrete

Use MDOT Grade P-NC concrete with no fly ash and coarse aggregate 6AA meeting the requirements of Section 601.

Masonry Unit

Use Masonry units meeting the requirement of Section 913.

Granular Material Class II

Use Granular Material Class II meeting the requirements of Section 902.

c. Construction

Adjust and reconstruct water shutoffs or valve boxes to the final grade or as approved by the Engineer or authorized representative. Replace shutoff or gate box materials damaged during adjustment or reconstruction, as determined by the Engineer, or authorized representative, at no additional cost to the City of Kalamazoo.

Remove pavement around the existing gate box and remove gate box in accordance with Section 204. Salvage existing gate box and place in a secure location for pick up and notify the Engineer when all gate boxes are ready for pick up. Place four (4) evenly spaced masonry units around gate valve ensuring the gate box rests on the masonry units and not the valve. Install gate box level and plumb. Backfill in accordance with Subsection 204.03 ensuring the gate box does not shift during backfilling. Adjust cover to final grade after placement of final road surface and hold in place with a concrete collar uniformly placed around the gate box to a depth of 6-inches minimum or as instructed by the Engineer with the top of the concrete flush with the top of the final road surface.

Valve Boxes

1. Place valve boxes plumb over the operating nut of the valve, with the box cover flush with the pavement, or as approved by the Engineer or authorized representative. Provide firm support for valve boxes using concrete bricks.

2. Valve boxes shall be installed, centered and plumbed over the operating nut of the valve. The area around the valve box shall be back-filled with Granular Material Class II placed in layers not to exceed 12 inches, and thoroughly compacted to the required density. The Contractor shall take due care to prevent the box from shifting during backfilling operations. The tops of the valve boxes shall be flush with the established pavement or ground surface.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Gate Box, Reconstruct, Modified	Each

The unit price for Gate Box, Reconstruct, Modified includes all labor, equipment, and materials to remove the existing pavement and backfill, and install the gate box, backfill and compact, and place the concrete collar.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

INSULATION BOARD

a. Description

This work consists of insulating the proposed or existing sanitary sewer, water main, or service lines at locations shown on the plans, or determined at the time of construction, to protect against the penetration of frost. This work includes furnishing and placing insulation board to the prepared grade. It also includes excavating, backfilling, shaping, and compaction necessary to install the insulation board.

b. Materials

Furnish insulation that is rigid, extruded polystyrene board meeting *ASTM C578, Type VII*, having a nominal board thickness of 2 inches, minimum compressive strength of 60 psi (*ASTM D1621*), minimum R value of 5.0 degree Fahrenheit square-foot hour per British thermal unit (°F ft^2 h/BTU) per inch and 0.1 percent max water absorption (*ASTM C272*/C272M). Furnish the board in minimum 4 foot by 8 foot sheets unless otherwise approved by the Engineer, and of the cumulative thickness as indicated on the plans or as determined at the time of construction and approved by the Engineer. Trim the edges square and ensure there is not more than 1/4-inch bow measured against a straightedge.

Furnish Class II granular backfill in accordance with subsection 902.07 of the Standard Specifications for Construction.

c. Construction

It is necessary to insulate the sanitary sewer, water main, or service lines wherever indicated on the plans or determined at the time of construction. Hand dig as necessary to verify the location of the sanitary sewer and water main. Place the insulation board on a prepared grade 6 inches above the top of the pipe, or a minimum of 2.5 feet below finished grade and fastened with skewers or other means approved by the Engineer, so that backfill compaction requirements of the trench can be met. Trim the surface of the grade to a smoothness of ±3/4 inch per 10 feet. With approval of the Engineer, the specified smoothness may be obtained by the placement of a thin layer of granular material Class II. Ensure where necessary to place more than one layer of insulation board, the joints are staggered. Ensure backfill and compaction equipment is approved by the Engineer.

Asphalt or other material having a temperature exceeding 150 °F must not be placed in direct contact with the insulation board.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Insulation Board, 2 Inch	Square Foot

Insulation Board, 2 inch includes furnishing, cutting and installing the insulation board complete including fasteners and any required granular material Class II. Also, the Contractor is responsible for hand digging to verify the location and elevation of the water main or service line.

CITY OF KALAMAZOO

<u>SPECIAL PROVISION</u>

FOR

VALVE AND BOX, _ INCH, MODIFIED

a. Description

For the unit prices bid for the respective sizes and types of valves and boxes, as defined below under the heading "Measurement and Payment", the Contractor shall do all work and furnish all materials and equipment necessary to install valves and boxes as shown on the plans and as specified herein.

<u>Work Included Under Other Contract Items</u>

Water Main and Fittings
Connections to Existing Main
Water Services
Fire Hydrants
Hydrant, Rem

<u>Work Included</u>

The work under these items as defined below includes all equipment, materials, work, and operations necessary to install and construct the valves and valve boxes, that is: earth excavation, removal of pavement, curbs, gutters, sidewalks, etc., care of structures, sheeting and shoring, removal and disposal of water, disposal of excess excavated materials, placing the valves and joining them to the pipe lines, setting valve boxes, backfilling, cleaning up and any other related work not enumerated and not included under other Contract Items.

b. Materials

Valves and valve boxes shall be supplied new by the Contractor, unless otherwise specified. No second hand or salvaged material shall be allowed or supplied. All Contractor supplied products shall be **"Buy America"** unless otherwise specified and shall comply with the conditions of this section.

<u>Ductile Iron Valves</u>

1. All underground valves in sizes from 4 inches to 10 inches shall be reduced wall, resilient seated gate valves for water supply service meeting the requirements of AWWA C 515. Valves shall be American Flow Control Series 2500, Clow model 2638, or EJ Flowmaster Series resilient seated gate valve, Mechanical joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel stem, mechanical joint restraint, and ¾ inch tee head bolts. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.

    a) In lieu of a mechanical joint restraint, American Flow Control Series 2500 valves may be equipped with ALPHA joints.

2. All underground valves 12 inches and larger shall be rubber-seated butterfly valves meeting the requirements of AWWA C 504. Valves shall be Pratt Groundhog Butterfly Valves, by Henry Pratt Company, Clow, M&H, or Kennedy model 4500, mechanical joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, mechanical joint restraint, and ¾ inch tee head bolts. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.

3. All above ground or in pits/vaults valves between 3 inches and 10 inches shall be rubber seated gate valves meeting the requirements of AWWA C515. Valves shall be American Flow Control Series 2500 Resilient Wedge Gate Valve, Clow model 2638, EJ Flowmaster Series, or approved equal with flanged joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel bolts, nuts and washers, stainless steel stem, and be equipped with a hand wheel to operate. Valves shall have a working pressure rating of 150 psi or greater.

4. All above ground or in pits/vaults valves 12 inches and larger shall be rubber seated butterfly valves meeting the requirements of AWWA C504. Valves shall be by Henry Pratt Company, Clow, M&H, or Kennedy, flanged joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, and ¾ inch stainless steel bolts, washers and nuts. Valves shall open right (clockwise) and be equipped with standard wheel to operate. Valves shall have a working pressure rating of 150 psi or greater.

5. All underground valves in sizes from 4 inches to 16 inches used in combination with a tapping saddle shall be reduced wall, resilient-seated gate valves for water supply service meeting the requirements of AWWA C 515. Valves shall be American Flow Control Series 2500, Clow model 2638, EJ Flowmaster Series with one flanged and one mechanical joint ends with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel stem, mechanical joint restraint, and ¾ inch tee head bolts or approved equal. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.

6. All valves used in conjunction with a fire service line shall be Mueller R-2361-6 Outside Screw and Yoke (O.S.&Y.) with sample tap or approved equal. The stem shall be type 304 stainless steel. Sample tap shall have a 4 ½ inch brass nipple, brass ball valve, and brass plug meeting NSF/ANSI Standard 61 requirements. Sample tap shall be ½ inch for 4 inch and smaller valves and ¾ inch for valves larger than 4 inch.

7. All valves installed using the insertion style method shall be an all stainless steel body Resilient Wedge Gate Valve designed for permanent use in potable water systems. The design will allow the valve to be installed into an existing pressurized pipeline while maintaining constant pressure and service without system shutdown. No restraining devices, restraining fasteners, or transition gaskets shall be required for the installation or operation of the valve. Valves in sizes 4 inches to 12 inches shall be Hydra-Stop Insta-Valve 250 or approved equal. 16 inch valves shall be Hydra-stop Insta-Valve Plus 250 or approved equal.

Valve Boxes and Vaults

1. Gate Valve Box or 2 inch Service Box – The valve box shall be of adjustable length screw type. The valve box shall be a malleable iron casting conforming to subsection 908.03 of the 2020 Michigan Department of Transportation Standard Specifications for Construction. Valve box shall either be a two or three piece screw type and the cover shall be inscribed with the word "WATER". Valve box 8550 Series (two piece) or 8560 Series (three piece) manufactured by EJ, 4905 size no. 22 manufactured by Bingham & Taylor, or approved equal.

    a) Gate Valve Box extensions shall be cast iron and manufactured by EJ or Bingham & Taylor, capable of being mounted directly to the gate valve box.

2. Valve Vaults for Insta-Valves – Valve vaults used in conjunction with Insta-Valves shall be constructed with materials as detailed in WA-8-A of the City of Kalamazoo Standard Specifications for Water Main and Service Installation 2021. They shall be of the diameter specified and in accordance with subsection 823.02 of the Michigan Department of Transportation Standard Specifications for Construction for Gate Wells.

c. Construction

Valves

1. Prior to installation, all valves shall be: 1) fully operated open and close to verify functionality, 2) number of turns to open valve shall be recorded, along with valve make, model and serial number, and 3) valve shall be washed with chlorinated water with a maximum concentration of 200 ppm. Set and join valves to the water mains as required for cleaning, laying, and joining the required type of pipe, as shown on the plans. Install valves as required by the contract, or as approved by the Engineer. Place the valve stems plumb. Install valves to not bear on the pipe. Install anchor coupling with valves installed on tees or crosses, with swivel gland located on the valve side of the anchor coupling.

2. When installing 12 inch and larger valves (Butterfly Valves), the operating nut shall be located on the side of the valve furthest from the centerline of the roadway and out of the wheel path, unless otherwise directed by the Engineer.

Valve Boxes

1. Place valve boxes plumb over the operating nut of the valve, with the box cover flush with the pavement, or as approved by the Engineer or authorized representative. Provide firm support for valve boxes using concrete bricks.

2. Valve boxes shall be installed, centered and plumbed over the operating nut of the gate valve. The area around the valve box shall be backfilled with Granular Material Class II placed in layers not to exceed 12 inches, and thoroughly compacted to the required density. The Contractor shall take due care to prevent the box from shifting during backfilling operations. The tops of the valve boxes shall be flush with the established pavement or ground surface.

3. Valve boxes in the roadway – See Gate Box, Adjust, Case 1, Modified

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Gate Valve and Box, 4 inch, Modified	Each
Gate Valve and Box, 6 inch, Modified	Each
Gate Valve and Box, 8 inch, Modified	Each
Butterfly Valve and Box, 16 inch, Modified - Installation	Each
Butterfly Valve and Box, 24 inch, Modified	Each

The unit prices of Gate Valve and Box, of the types and sizes required, include the cost of furnishing and installing the valve and valve box, complete and ready for use. Contractor shall provide concrete bricks for valve box foundation/support.

The unit price of Butterfly Valve and Box, 16 inch, Modified - Installation, includes the cost of installing a **City provided valve**, complete and ready for use. Contractor shall provide and install the valve box and concrete bricks (for valve box foundation/support). City shall provide and deliver the valve to the project.

The unit price of Butterfly Valve and Box, 24 inch, Modified, include the cost of furnishing and installing the valve and valve box, complete and ready for use. Contractor shall provide concrete bricks for valve box foundation/support.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

WATER MAIN AND FITTINGS

a. Description

General

For the unit price per linear foot bid for the various water main, the Contractor shall do all work necessary to construct complete ready for service water main system and test the water main as shown on the plans and as specified, except for work which is specifically included under other contract items. All work shall be done in accordance with section 823 of the 2020 MDOT Standard Specifications for Construction and City of Kalamazoo Standard Specifications for Water Main and Service Installation 2021, unless otherwise specified herein.

Work Included Under Other Contract Items

Valves and Boxes
Fire Hydrants
Fire Hydrant, Rem
Connect to Existing Main
Water Services

b. Materials

Ductile Iron pipe, restrained joints, fittings and associated appurtenances shall be supplied new by the Contractor. No second hand or salvaged materials shall be allowed or supplied. All supplied products shall be **"Buy America"** unless otherwise specified and shall comply with the conditions of this section.

Contractor shall review the plans during bidding and throughout construction. If Contractor believes additional quantities will be required, Contractor shall immediately notify the City in writing. City shall not be responsible for any downtime or construction delays associated with insufficient materials being available during construction. Contractor shall be responsible for all delays and downtime associated with Contractor supplied materials.

Ductile Iron Pipe Specifications

1. Ductile Iron Pipe shall be manufactured in accordance with American National Standards Institute (ANSI) and American Water Works Association (AWWA) ANSI/AWWA C150/A21.50 and C151/A21.51. Pipe shall be minimum thickness Class 52 pipe. Flanged pipe shall be manufactured in accordance with ANSI/AWWA C 115/A21.15. Pipe through concrete floors or foundations shall be minimum thickness Class 53 pipe.

    a. Water pipe must be lined with a standard thickness cement mortar lining sealed with a bituminous seal coat in accordance with ANSI/AWWA C104/A21.4, unless otherwise required. The outside of the pipe must be coated with the standard bituminous seal and each length of pipe must be marked with the following information:

        i. Metal thickness class.
        ii. Net weight of the pipe without lining.
        iii. The nominal size.
        iv. The manufacturer's identifying symbol.

    b. Underground pipe shall be push on or mechanical joints and above ground pipe shall be flanged joints with gaskets meeting the requirements of ANSI/AWWA C111/A21.11. Nitrile or fluoroelastomer gaskets shall be used as indicated on the plans and in locations of known or suspected soil or groundwater contamination as necessary. Gaskets provided will be specified based on the type of contamination that is encountered. Each joint shall contain serrated silicon bronze electrical continuity wedges as directed by the Engineer or authorized representative. 4 to 6 inch pipe shall use 2 wedges, 8 to 12 inch pipe shall use 3 wedges, and 16 inch and above shall use 4 wedges.

    c. Pipe used in conjunction with Horizontal Directional Drilling operations shall be Flex-Ring or TR FLEX joints.

Restrained Joints

1. Restrained joints shall meet the requirements of ANSI/AWWA C111/A21.11, and AWWA/ANSI C110/A21.10 or ANSI/AWWA C153/A21.53.

2. Mechanical restrained joints shall be EBAA Iron Megalug series 1100, Romac Romagrip, Ford Series 1400, or approved equal.

    a. Restraint devices for nominal pipe sizes 4 inch through 54 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

    b. The devices shall have a working pressure rating of 350 psi for 4 to 16 inch, 250 psi for 18 to 48 inch and 200 psi for the 54 inch size. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

    c. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.

    d. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.

e. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

f. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

g. All components shall be manufactured and assembled in the United States.

h. Coating for restraint devices shall consist of the following:

i. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

ii. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.

iii. The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal.

3. Push on restrained joint shall be field locking gasket or Flex Ring style as manufactured by US Pipe, McWane, American USA, or approved equal. Field locking or Flex Ring gasket shall match appropriately to the manufacturer of the pipe used.

4. Use of threaded rods or thrust blocks as a restrained joint shall not be permitted, unless approved by the Engineer.

5. Restrained flange adapters shall be EBAA Iron Megaflange series 2100 or approved equal.

a. Restrained flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125#/Class 150 Bolt Pattern).

b. Restraint for flange adapter shall consist of plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

c. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum of 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

d. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. The coating shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

e. Restraint Ring coated with MEGA-Bond Restraint Coating System.

Ductile Iron Pipe Fittings

1. Fittings, plugs, and gaskets must meet the requirements of ANSI/AWWA C111/A21.11, and AWWA/ANSI C110/A21.10 or ANSI/AWWA C153/A21.53. Cement mortar linings for fittings must meet the requirements of ANSI/AWWA C104/A21.4.

2. Mechanical joints shall be EBAA Iron Megalug series 1100, Romac Romagrip, or approved equal.

3. Restrained flange adapters shall be EBAA Iron Megaflange series 2100 or approved equal.

Polyethylene Encasement

Polyethylene encasement shall be V-Bio®. Provide the tube size recommended by the manufacturer to protect the pipe and fitting sizes. Contractor shall provide adhesive tape for the polyethylene tube as recommended by the manufacturer. Tape for joining and repairing damage to the polyethylene must have a life expectancy equal to or greater than the life expectancy of the polyethylene.

Backfill Materials

Use materials meeting the requirements of section 902 of the 2020 Michigan Department of Transportation *Standard Specifications for Construction*.

c. Construction

General

1. The plans show the locations of existing utilities in accordance with available data. If the work requires precise information on the location of existing utilities, the Contractor will expose utilities to determine the actual locations.

2. Do not disturb or cut into existing in-service water mains. If the operation of valves in existing water mains is required, notify the City of Kalamazoo a minimum of 3 working days in advance. Coordinate scheduling of water main connections with the City of Kalamazoo. Secure the Engineer's or authorized representative's approval of the schedule before beginning the work.

3. The City of Kalamazoo will open or close in service valves and provide on-site inspections for all water main and water service installations.

4. Limit out of service time for existing water mains to 4 hours and provide minimum 72 hours advance notice to the City's Project Manager prior to planned service interruptions.

5. No trees or permanent structures shall be placed within 10 feet of the centerline of the water main or service line.

Trench Excavation

1. Excavate water main trenches to the lines and grades shown on the plans in accordance with modifications approved by the Engineer, or authorized representative, or to meet or bypass existing utility structures. Excavate trenches to the depths shown on the plans to provide 5 feet of cover from top of water main to the final grade. Excavate trenches to the widths shown on Michigan Department of Transportation Standard Plan R-83 Series.

2. Excavate the bottom of the trench to the required grade to allow 6 inches of bedding for the pipe. Do not block under the pipe.

4. Maintain trenches for water mains free of ground or surface water by pumping or as otherwise approved by the Engineer or authorized representative

5. Install, and later remove, temporary timber bracing, as required to prevent movement or damage to new or existing water mains or adjacent utilities.

6. During backfilling, carefully remove supports for sheeted and braced excavations to prevent earth banks or adjacent streets from collapsing.

7. The Contractor may leave sheeting and bracing in place during backfilling and remove after completing backfilling operations. The Contractor may leave sheeting and bracing in place, if approved by the Engineer and the Contractor cuts it off 5 feet below the ground surface.

Disposal

Dispose of any waste material in accordance with section 205 of the 2020 MDOT Standard Specifications for Construction.

Laying the Pipe

1. The contractor shall wash the inside of all pipe, fittings, valves, hydrants, etc. with chlorinated water (200 ppm) during the day of installation (preferably immediately before installation) and the interior of each pipe, fitting, valve, hydrant, etc. shall be inspected immediately before and during installation. Water pressure during washing shall not exceed manufactures recommendations or damage the pipe, etc.

2. Install the pipe joint restraint system in accordance with the manufacturer's recommendations, or as directed by the Engineer. Assemble the pipe in the trench. If deflections at joints are required by changes in grade, alignment, or to plumb valve stems, ensure deflections of bell and spigot joints and mechanical fitting joints do not exceed three-quarters of the maximum deflection recommended by the joint manufacturer or that allowed by AWWA C600, whichever is less. Do not store or leave tools or other objects in the pipe.

3. Install restrained joints as indicated on the plans, in Table 3.1, and as directed by the City. No tie rods or thrust blocks shall be allowed unless approved by the Engineer or authorized representative.

4. Proper actuation of the gripping wedges of the mechanical joint restraint shall be ensured with torque limiting twist off nuts.

5. The Contractor shall provide a written statement of warranty (Warranty Bond) for a period of 2 years from the date of final acceptance (after all service connections are complete).

6. Warranty work shall cover any necessary cost to repair water main or appurtenance leaks and water main or appurtenance leak damage at no cost to the City of Kalamazoo. Final acceptance will only be given once all water service connections are complete.

7. Pipe shall be laid with bell ends facing the direction of laying, unless otherwise directed by the Engineer or authorized representative. When pipe is laid on a grade of 10 percent or greater, the laying shall start at the bottom and proceed upward with the bell ends of the pipe upgrade.

8. Install silicon bronze wedges between all push-on joint pipes to allow for underground location and thawing of pipeline. 4 to 6 inch pipe shall use 2 wedges, 8 to 12 inch pipe shall use 3 wedges, and 16 inch and above shall use 4 wedges at each pipe joint.

Pipe shall be restrained in accordance with Table 3.1.

Table 3.1 Pipe Thrust Restraint Table

NON-POLYWRAPPED PIPE

Pipe Size (Inches)	90° Bend	45° Bend	22.5° Bend	11.25° Bend	Tee*	Reducer (One Size)	Reducer (Two Sizes)	Dead End
4	44	18	9	5	42	-	-	42
6	62	26	13	7	59	31	-	59
8	82	34	17	9	78	33	56	78
10	100	42	20	10	94	32	58	94
12	119	50	24	12	110	33	59	110
16	157	65	32	16	143	61	85	143
20	195	81	39	20	173	61	109	173
24	233	97	47	23	204	61	111	204
30	288	120	58	29	246	86	134	246

POLYWRAPPED PIPE

Pipe Size (Inches)	90° Bend	45° Bend	22.5° Bend	11.25° Bend	Tee*	Reducer (One Size)	Reducer (Two Sizes)	Dead End
4	62	26	13	7	60	-	-	60
6	88	37	18	9	84	44	-	84
8	117	49	24	12	111	47	80	111
10	142	59	29	14	133	45	82	133
12	170	71	34	17	158	47	84	158
16	224	93	45	23	203	87	121	203
20	278	116	56	28	247	87	155	247
24	332	138	66	33	291	87	159	291
30	411	171	82	41	351	123	191	351

* Length of restraint for branch; use the size of the branch

Consult Engineer for scenarios not included in table.

Abandoning Water Mains

Remove and dispose of abandoned pipe, gate boxes, or other appurtenances, as necessary for placement of a new water main at no additional cost to the City of Kalamazoo. Remove gate boxes completely. If the Engineer determines abandoned mains may remain in place, cap the end of pipe with cap and megalug or as directed by the Engineer or authorized representative. If shown on the plans or directed by the Engineer or authorized representative, fill abandoned water mains with nonstructural flowable fill.

Water Mains, Cut and Plug

All work related to water main, cut and plug shall be in accordance with section "Abandoning Water Mains" above. If the plans show cutting and plugging water mains, arrange for the City of Kalamazoo to shut down the main. Remove the section of pipe and plug/cap the water main as shown on the plans or as approved by the Engineer or authorized representative. Construct the required restraint/thrust block as directed by the Engineer or authorized representative. All capped or plugged water mains shall be restrained with a precast thrust block, steel pile or other approved method. Caps/plugs installed on in-service water mains shall be disinfected w/ 1% bleach solution prior to installation.

Miscellaneous Fittings

Install the following at the locations shown on the plans and in accordance with good construction practices and manufacturer recommendations:

1. Elbows,
2. Tees,
3. Corporation stops,
4. Blow offs,
5. Pipe adapters,
6. Pipe couplings,
7. Retaining glands, and
8. Other miscellaneous fittings

Backfilling and Compacting

1. Backfill and compaction shall be in accordance with the Michigan Department of Transportation Standard plan for utility trenches R-83-Series.

2. Backfilling Under Existing Conduits – Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with granular bedding material tamped in place in 6-inch layers to the required density. The granular bedding shall extend outward from the spring line of the conduit a distance of 2-feet on either side and thence downward at its natural slope.

3. Backfilling with Excavated Material – Unless otherwise specified or directed, material excavated in connection with the work shall be used for backfilling and other purposes, if it meets all requirements given elsewhere in this specification.

4. Backfill Immediately Following Inspection – All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the Engineer or authorized representative. Under no circumstances shall water be permitted to rise in

un-backfilled trenches after pipe has been placed.

5. Fittings, valves, and taps shall not be backfilled until Engineer or authorized representative has collected measurements and Contractor has recorded GPS coordinates of the item.

6. Backfilling around and over structures and pipes shall be carefully done by hand and tamped with suitable tools of approved weight to a point 1-foot above the top of pipe. Selected material or, where specified or ordered by the Engineer, special backfill material shall be used in this area. The material shall be placed in uniform layers not exceeding 6-inch in depth up each side. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of pipe or structure.

7. Backfilling by Machinery – After the backfill has been placed and compacted around the boxes and pipe to a height of 1-foot above the top, the remainder of the trench may be backfilled by machine. The backfill material shall be deposited in horizontal layers and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfill material from a bucket be allowed to fall directly on a structure or pipe and in all cases the bucket must be lowered so that the shock of the falling material will not cause damage.

Compaction Requirements

Compact each layer to 95% (90% if outside the influence of the roadway) maximum density as tested by the Michigan Department of Transportation Density Testing and Inspection Manual.

Compaction Testing

1. Trenches and excavation around structures shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Compaction tests shall be performed on each layer immediately after compaction.

2. Initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain the required compaction. Any change in the proven method of consolidations will require additional testing and field verification of compaction.

3. Subgrade below pavements, curbs, sidewalks, and structures shall be consolidated as specified. Compaction tests shall be performed to verify specified consolidation.

Hydrostatic Testing

1. Perform hydrostatic testing of water mains in accordance with AWWA C600.

2. Ensure City of Kalamazoo personnel witness pressure testing. Give the City of Kalamazoo personnel at least 2 full working days notice before testing.

3. Provide the personnel, temporary timber bracing, plugs, test pumps, temporary connections to the Municipal water system, and any other required apparatus. Provide the water for hydrostatic testing if not available from the City of Kalamazoo. Water must be pumped from a measurable source in order to determine testing allowance water.

4. Before applying test pressure, expel air from the pipe in increments of no greater than

1,000 feet. Pressure test each section of water main. If the Contractor chooses not to pressure test against an existing valve, a new valve may be installed at the expense of the Contractor.

5. Pipe shall be pumped with water to a minimum test pressure of 150 pounds per square inch (psi) at the highest point of elevation to begin test. Test shall last for at least 2 hours, with a maximum drop of pressure of 5 psi. If the pressure drop is greater than 5 psi but less than 20 psi, a testing allowance water test shall be performed. Testing allowance water, as measured by the quantity of water pumped into the pipe to attain the pressure at which the test began must not exceed the testing allowance.

6. Testing allowance water is determined using the following formula

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where,
L= testing allowance water in gallons per hour
S= length of pipe in feet
D= actual pipe diameter in inches, and
P= 150 psi

7. If testing allowance water is above the allowable limit, remove backfill to expose pipe and repair the joints. Repeat testing after repairs are complete. If multiple leaks occur the contractor may be required to reinstall main at Contractors expense.

8. Correct visible leaks regardless of the amount of leakage. Replace faulty pipes, fittings, gate valves, or other accessories disclosed by testing. Repeat the test until the pipes, fittings, gate valves, and other accessories meet the requirements.

Disinfection, Flushing and Bacteriological Testing

1. Disinfect the water main in accordance with AWWA C651 and applicable Michigan Department of Environment, Great Lakes, and Energy (EGLE) regulations after successful hydrostatic testing.

2. Disinfect and flush new, and portions of existing, water mains as required by the EGLE.

3. Use blow offs, fire hydrants, or other means as shown on the plans or approved by the Engineer, or authorized representative, to flush water mains in accordance with AWWA C651, with a velocity of at least 3 feet per second. Provide hoses and other equipment and arrange a means of disposing of the water without damaging the work or adjacent property.

4. Use the continuous feed method with chorine added simultaneously with the water. Add chlorine or liquid hypochlorite to meet the requirement of at least 25 milligrams per liter of chlorine. Slowly add the water to the main and allow it to stand for at least 24 hours. At the end of the 24-hour period, ensure the chlorine residual is a minimum of 10 milligrams per liter. If not met, re-chlorinate and flush the water main until a minimum 10 milligrams per liter residual remains after 24 hours.

5. After completing disinfection, initially flush the water mains with water at a velocity of at least 3 feet per second to replace the entire volume of chlorinated water in the pipeline.

After initial flushing, perform final flushing until the residual chlorine content meets the standard level for the water distribution system. The City of Kalamazoo may require a waiting period after flushing and before bacteriological sampling.

6. Dispose of chlorinated water in accordance with applicable state and local requirements. If necessary, apply a reducing agent to the water to neutralize the chlorine and create a chlorine residual of no greater than 1 ppm. Dechlorination shall be in accordance with AWWA C655.

7. After flushing, perform bacteriological testing in accordance with AWWA C651 and EGLE requirements. Test chlorine residuals before taking each bacteriological sample. Ensure the chlorine residual is less than 1.5 milligrams per liter before taking a bacteriological sample. The City of Kalamazoo will collect samples from each branch of pipe in the presence of the Engineer, or authorized representative, and contractor personnel. The City of Kalamazoo will be responsible for the transportation of the samples to a State of Michigan approved lab for testing. Two consecutive bacteriologically safe tests at 24-hour intervals for each section of pipe are required. Acceptable tests are negative for bacteria and as otherwise defined by AWWA C651 and EGLE regulations.

8. If a bacteriological test fails, repeat disinfection, flushing, and testing.

9. Pressure and chlorination taps shall be removed within one business day of passing tests, so main can be activated. City shall witness tap removal and plug installation.

Live Taps to in Service Water mains

1. Prior to tapping of the main contractor shall disinfect all pipe, appurtenances, tapping machine with chlorinated water.

2. Contractor shall install all necessary tapping appurtenances according to manufacturer's recommendation.

3. Contractor shall use equipment which allows the tapping machine to rinse out metal shavings and tap water main per manufacturer's recommendations. No tap 4 inches or larger shall be allowed within 4 feet from any joint, fitting, or existing tap regardless of location of tap. 1 ¼ inch taps located within 10 feet of previous tap shall be offset 15 degrees.

4. Once tapping is complete Contractor shall disinfect all exposed water main and appurtenances with chlorinated water.

Polyethylene Encasement

1. Polyethylene encasement shall be V-Bio®

2. V-Bio® polyethylene encasement of all water main and fittings is required.

3. Install V-Bio® polyethylene encasement on water mains and fittings in accordance with the manufacturer's installation instructions and AWWA/ANSI C105/A21.10.

4. Appropriately sized V-Bio® polyethylene encasement shall be used so that there are no longitudinal spices. This may require using one or more size larger diameter encasement than the pipe installed.

As-Constructed Plans

1. As-constructed plans shall be provided to the City within two weeks of water main and service installation completion.

2. GPS survey shall be completed during construction using a method with ± 1 foot lateral accuracy, or better.

3. Michigan State Plane South Coordinate System shall be used and grid to ground scale shall be noted. Coordinate system shall be: NAD_1983_2011_STATE PLANE FiPS 2113 (international feet).

4. As-constructed plans shall include a csv file with GPS coordinates for the water main (at minimum 60 foot intervals) and all water main appurtenances and services. A column in the csv file shall identify the asset (90, 45, tee, tap, valve, hydrant, etc.)).

5. A map depicting the location of the water main and appurtenances, where joint restraint is provided, and associated features shall be provided in PDF format and as an AutoCAD DWG file.

d. Measurement and Payment

1. Payment for Water Mains shall be measured based on the sizes and trench details required, along the centerline of the pipe, with no deductions for fittings. The unit price of Water Main, DI, includes the cost of the following:

    a. Excavation and backfill;

    b. Dewatering operations (trench and/or pipe), including pretreatment to remove sediment;

    c. Provide temporary water system to maintain service during construction;

    d. Hydrostatic testing;

    e. Disinfecting and flushing the water main and bacteriological testing;

    f. All materials, labor and equipment necessary to remedy an unsatisfactory hydrostatic test, including removing and replacing any backfill, surfacing materials, etc.

    g. Installing fittings, gaskets, bracing or sheeting, blocking and miscellaneous items for installing pipe and reconnecting to the water distribution system

    h. Preparing and providing **as-constructed plans** within two weeks of water main completion as described herein.

2. The City of Kalamazoo may withhold payment and/or final acceptance until the City of Kalamazoo accepts the as-constructed plans.

3. The cost of dewatering trenches, pits, pipe, etc. associated with alterations to the Municipal Water System, is included in the unit price for relevant items of work.

4. The cost of excavating, disposing of excess material, and providing, placing, and compacting the backfill, is included in the unit price for related items of work.

5. The cost of removing or abandoning existing water mains, gate valve boxes, and other appurtenances to provide clearance for the proposed water main or roadway, is included in the unit price for relevant items of work.

The Contract Items included under this category of "Water Main and Fittings" are as follows:

Pay Item	*Pay Unit*
Water Main, Abandon with Flowable Fill	Foot
Water Main, DI, 4 inch, Tr Det G, Modified	Foot
Water Main, DI, 6 inch, Tr Det G, Modified	Foot
Water Main, DI, 8 inch, Tr Det G, Modified	Foot
Water Main, DI, 16 inch, Tr Det G, Modified	Foot
Water Main, DI, 24 inch, Tr Det G, Modified	Foot
Water Main, 4 inch, Cut and Plug, Modified	Each
Water Main, 6 inch, Cut and Plug, Modified	Each
Water Main, 8 inch, Cut and Plug, Modified	Each
Compact Ductile Iron Fittings	Pound
Polyethylene Encasement	Foot

Payment for Water Main, __inch, Cut and Plug includes the cost of cutting the existing water main, and placing the required plugs/caps and thrust blocks.

Payment for Compact Ductile Iron Fittings shall be made on the basis of the following tables of weights for mechanical joint ductile iron compact fittings. Solid sleeves, restraints, and joint accessories are not included in the following weights and will not be measured separately for payment.

Bends and Solid & Tapped Plugs & Caps (all weights are in Pounds)

Size	90° Bends Weight	45° Bends Weight	22 ½° Bends Weight	11 ¼° Bends Weight	Solid & Tapped Plugs	Solid & Tapped Caps
4”	26	22	21	18	10	10
6”	43	36	34	30	18	17
8”	64	55	46	44	26	25
10”	96	74	67	61	36	35
12”	122	111	80	74	46	44
14”	220	164	148	93	79	69
16”	264	202	178	158	100	92
18”	410	289	292	287	130	122
20”	505	348	364	346	153	148
24”	664	475	460	457	202	202

Tees & Reducers (all weights are in Pounds)

Size	Tee	Cross	Reducers
4”	35	42	---
6” x 4”	51	62	27
6”	60	80	---
8” x 4”	71	84	36
8” x 6”	80	105	38
8”	90	111	---
10” x 4”	83	98	47
10” x 6”	93	110	47
10” x 8”	111	138	54
10”	120	155	---
12” x 4”	105	115	65
12” x 6”	115	129	60
12” x 8”	123	258	60
12” x 10”	153	180	64
12”	165	212	---
14” x 6”	183	210	108
14” x 8”	206	231	104
14” x 10”	229	255	100
14” x 12”	235	269	100
14”	281	299	---
16” x 4”	224	---	---
16” x 6”	229	250	132
16” x 8”	248	264	128
16” x 10”	265	286	128
16” x 12”	281	310	125
16” x 14”	317	363	140
16”	323	410	---
18” x 6”	275	---	---
18” x 8”	280	---	194
18” x 10”	286	---	196
18” x 12”	370	---	185
18” x 14”	415	---	190
18” x 16”	445	---	196
18”	490	---	---
20” x 6”	335	---	---
20” x 8”	383	---	---
20” x 10”	410	---	225
20” x 12”	432	---	210
20” x 14”	475	---	208
20” x 16”	530	---	225
20” x 18”	560	---	233
20”	605	---	---
24” x 6”	454	---	---
24” x 8”	475	---	---
24” x 10”	505	---	---
24” x 12”	454	---	310
24” x 14”	585	---	315
24” x 16”	625	---	325
24” x 18”	675	---	312
24” x 20”	740	---	315
24”	830	---	---

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

WATER MAIN LINE STOP

a. Description

This work consists of providing, installing and operating a water main line stop (Hydra-Stop) to isolate a section of existing live water main as shown on the plans and described herein.

Work Included Under Other Contract Items

Water Main and Fittings
Valves and Boxes
Connect to Existing Main

b. Materials

Provide materials in accordance with section 823 of the 2020 MDOT Standard Specifications for Construction and with the Special Provision for Water Main and Fittings. Submit catalog cuts to the Engineer for approval prior to ordering line stop materials.

c. Construction

Complete all work in accordance with the Special Provision for Water Main and Fittings. Verify the material, size, ovality and condition of the existing water main prior to ordering the line stop materials.

Verify the pressure in the existing main is below the line stop manufacturer's recommendation before installation of the line stop.

Do not attempt to force, reshape, or bend saddle plates by excessive tightening of saddle studs.

Utilize concrete supports and reaction blocking for the line stop fitting.

Complete a pressure test after assembly of the line stop saddle, drain nozzle and fitting.

Install a completion plug, blind flange and check for water tightness prior to abandonment of the line stop fitting. Coat the whole assembly with a coal tar epoxy to a final minimum cured thickness of 0.020 inches.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Water Main Line Stop, 4 inch	Each
Water Main Line Stop, 6 inch	Each
Water Main Line Stop, 8 inch	Each

Water Main Line Stop, _ inch includes payment in full for furnishing all material, labor and equipment necessary to perform the work specified herein and shown on the plans.

Perform all work required in conjunction with dewatering operations, without separate payment, and consider it is included in the **Water Main Line Stop, _ inch** pay item.

Furnish all labor, equipment and materials for trench excavation, disposal, and backfill and consider it is included in the **Water Main Line Stop, _ inch** pay item.

Removal and replacement of pavement, curb, curb and gutter, and sidewalk will be paid for separately, based on actual quantities.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

WATER SERVICE ENCASEMENT

a. Description

For the unit price per linear foot bid for the various water services, the Contractor shall furnish all materials and do all work necessary to construct complete ready for service water service, except for work which is specifically included under other contract items. All work shall be done in accordance with section 823 of the MDOT Standard specifications for Construction and with the City of Kalamazoo 2021 Standard specifications for Water Main and Service Installation unless otherwise specified herein.

Work Included Under Other Contract Items

Water Services

b. Materials

Provide materials in accordance with section 823 of the 2020 MDOT Standard Specifications for Construction and with the City of Kalamazoo 2021 Standard Specifications for Water Main and Service Installation.

I. PVC Water Service Encasement Pipe and Fittings, NPS 8(DN 200) and Smaller: ASTM F 891, SDR 35 solid wall with solvent sealed joints using ASTM D 2855 solvent cement.

II. Polyethylene Water Service Encasement manufactured using 8 mil thick virgin polyethylene in accordance with ANSI/AWWA C105/A21.10. Provide the tube size recommended by the manufacturer to protect the pipe and fitting sizes. Provide adhesive tape for the polyethylene tube as recommended by the manufacturer. Tape for repairing damage to the polyethylene must have a life expectancy equal to or greater than the life expectancy of the polyethylene.

III. HDPE Water Service Encasement Pipe and Fittings: Type III, Class C, Category 5, Grade P34, ASTM D1248 SDR 17, 100 PSI ASTM D3035. Join pipes with butt fuse equipment and methods in strict accordance with manufacture’s recommendations and ASTM D3261.

c. Construction

Complete all work in accordance with the Standard Specifications, the City of Kalamazoo 2021 Standard Specifications for Water Main and Service Installation. All water services crossing steel and/or cathodically protected gas mains shall be encased a minimum 10’ on each side of the crossing. Contractor may select materials and methods of installation. Services installed by horizontal directional drilling may require encasement for the entire length of the service.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item. Payment for Water Service Encasement shall be measured along the centerline of the pipe, with no deductions for fittings.

Pay Item	*Pay Unit*
Water Service Encasement	Foot

Water Service Encasement includes payment in full for furnishing all material, labor and equipment necessary to perform the work specified herein and shown on the plans.

Perform all work required in conjunction with dewatering operations, without separate payment, and consider it is included in the **Water Service Encasement** pay item.

Furnish all labor, equipment and materials for trench excavation, horizontal directional drilling, disposal, and backfill and consider it included in the **Water Service Encasement** pay item.

CITY OF KALAMAZOO

<u>SPECIAL PROVISION</u>

FOR

WATER SERVICES

a. Description

This work consists of constructing proposed water services from the water distribution main to the curb stop valve, or as directed by the Engineer. The intent of this special provision is to replace all street side water services and connections between the proposed water main and the existing curb stop locations.

b. Materials

Copper service lines, tapping saddles, corporation stops, curb stops, curb boxes, valve boxes, and all other materials necessary shall be supplied new by the Contractor. No second hand or salvaged material shall be allowed or supplied. All supplied products shall be **"Buy America"** unless otherwise specified and shall comply with the conditions of this section.

<u>Copper Service Lines</u>

1. Copper pipe shall be used for service lines which are ¾ inch, 1 ¼ inch and 2-inch. All copper services shall conform to AWWA C800. Water service pipe shall be copper meeting the requirements of ASTM B88, type K.

2. All appurtenances on copper service lines shall be flare copper connections. Other connections may be used in lieu of flare copper connections if approved by the Engineer prior to installation.

3. All water service appurtenances shall meet the requirements of AWWA C800 and be from The Ford Meter Box Company, Inc., A.Y. McDonald Mfg. Co., or as approved by the Engineer. All water service appurtenances for 2 inch and smaller are as follows:
    A. ¾ inch services:
        i. Corporation Stop ¾ inch – FB600-3-NL or AY McDonald 74701B NL (3/4 inch)
        ii. Service Saddle – Smith-Blair 311(4 to 12 inch water main), Smith-Blair 313 (16 to 24 inch water main), Romac 101U(4 to 12 inch water main), Romac 202SSU (16 to 24 inch water main), Ford F101(4 to 12 inch water main), or Ford F202(16 to 24 inch water main).
        iii. Curb Stop (for use when reducing a 1 ¼ inch street service to ¾ inch yard service) – Ford B21-555-NL; C18-35-NL; and C28-33-NL; or AY McDonald 76102 W-NL, 5142-356; 72206 D-NL, 5429-036; 74753 – NL, 5120-139
        iv. Curb Stop (when using ¾ inch street service) – Ford B22-333-NL or AY McDonald 76100 NL (¾ inch)
        v. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
        vi. Couplings – Ford C22-33-NL or AY McDonald 74758 NL (¾ inch)
    B. 1 ¼ inch services:
        i. Corporation Stop – Ford FB600-45-NL or AY McDonald 74701B-NL, 5142-321 (1 x 1 ¼ inch)

ii. Service Saddle – Smith-Blair 311(4 to 12 inch water main), Smith-Blair 313 (16 to 24 inch water main), Romac 101U(4 to 12 inch water main), Romac 202SSU (16 to 24 inch water main), Ford F101(4 to 12 inch water main), or Ford F202(16 to 24 inch water main).
iii. Curb Stop – Ford B22-555-NL or AY McDonald 76100 NL (1 ¼ inch)
iv. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
v. Couplings – Ford C22-55-NL or AY McDonald 74758 NL (1 ¼ inch)

C. 2 inch services:
i. Tapping Valve – Ford B11-777-NL
ii. Service Saddle – Smith-Blair 313, Romac 202S, or Ford F202
iii. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
iv. Couplings – Ford C44-77-NL

D. All water service appurtenances larger than 2 inch shall be in accordance with "Ductile Iron" in the Special Provision for "Water Main and Fittings" included in this proposal.

4. Water meters – All water meters shall be Neptune Water Meters. They shall be supplied and installed by the City of Kalamazoo.
A. All multiple meter settings with more than two meters excluding the fire meter shall use a fabricated meter manifold.

Valve Boxes

1. Curb Stop Boxes for 1 ¼ inch Service – Bingham & Taylor Fig. No. 4901-B, 94-F with 2 ½" New Style Flush Fit Cover or approved equal. Cover shall be inscribed with the word "water".
A. Curb Stop Box extensions shall be cast iron and manufactured by Bingham & Taylor, capable of being mounted directly to the curb stop box.

2. Gate Valve Box or 2 inch Service Box – the valve box shall be of adjustable length screw type. The valve box shall be a malleable iron casting conforming to subsection 908.03 of the 2020 Michigan Department of Transportation Standard Specifications for Construction. This valve box shall either be a two or three piece screw type and the cover shall be inscribed with the word "water." Valve box 8550 Series (two piece) or 8560 Series (three piece) manufactured by EJ, 4905 size no. 22 manufactured by Bingham & Taylor, or approved equal.
A. Gate Valve Box extensions shall be cast iron and manufactured by EJ or Bingham & Taylor, capable of being mounted directly to the gate valve box.

METER BOXES AND VAULTS

A. All Meter Boxes, Meter Vaults and components shall be from the following manufactures.
1. Box – Hancor MP NL1 24 0008 - 24 inch x 48 inch or ADS24X48MP 24 inchx48 inch white corrugated meter pit or Engineer approved equal.
2. Vault – Precast concrete meter vault shall have a 3 inch minimum wall thickness and size shall be depended on number of meters and meter size. The wall shall have steps that are equally spaced 12 inches apart. Meter vault shop drawings shall be submitted to the Engineer and approved for each installation.
3. Meter Pit Cover – Vestal 32-497, 32-055, 32-104, and 32-046 or approved equal.
4. Meter Vault Cover – Ford MC-24HH-MB-T

c. Construction

This work shall be in accordance with this special provision, City of Kalamazoo Standard Specifications for Water Main and Service Installation 2021, and the 2020 MDOT Standard Specifications for Construction. The Contractor shall notify the City of Kalamazoo's Public Services Department before this work is to begin and follow all City procedures for notifying the water customers and residents.

Live Taps To In Service Water mains

Prior to tapping of the main, Contractor shall disinfect all pipe, appurtenances, tapping machine with chlorinated water.

1. Contractor shall install all necessary tapping appurtenances according to manufacturer's recommendation.

2. Contractor shall use equipment which allows the tapping machine to rinse out metal shavings and tap water main per manufacturer's recommendations. No tap 4 inches or larger shall be allowed within 4 feet of any joint, fitting, or existing tap regardless of location of tap. 1 ¼ inch taps located within 10 feet of previous tap shall be offset 15 degrees.

3. Once tapping is complete Contractor shall disinfect all exposed water main and appurtenances with chlorinated water.

Water Services

1. Water Services shall not be connected to the water main until approved by the Engineer or authorized representative.

    A. The standard size for all new services shall be 1 ¼ inch. The property owner/developer may request a larger size if needed.

¾ inch service materials may only be used when performing repairs or partial replacements of an existing ¾ inch service, or when replacing the yard service of a ¾ inch service. When replacing a complete street side service of a ¾ inch service, a new 1 ¼ inch tap will be completed, new 1 ¼ inch street service line installed, and service size shall be reduced down at the curb stop. Tap water main per "Live Taps to In Service Water Mains" above.

2. Water Services 2 inch and Smaller:

    A. Construct services from the distribution main to the water meter. Lay services in a straight line perpendicular to the water main unless approved by the Engineer or authorized representative. Construct service with a continuous piece of copper from the corporation stop to the curb stop and curb stop to the water meter unless approved by the Engineer or authorized representative. Services over 300 feet will require an exterior meter setting (meter pit).

    B. All couplings shall be located as close to the water main as possible, but outside roadway unless approved by the Engineer.

    C. The use of thread sealant shall not be allowed on flare fittings.

    D. No splices shall be allowed for 1 ¼ inch or smaller yard services 90 feet and shorter in length.

E. Tap and curb stop locations shall be no closer than 5 feet to edge of driveways. If a service is required to be abandoned due to improper location, service shall be fully abandoned at the water main tap location and new service installed at the developer's expense. Corporation stop shall be shut off, copper piping removed, and copper disc installed on the corporation stop.

F. If finish grade changes from plan grade after installation of service, curb stop shall be adjusted to 5 foot bury depth at the developer's expense.

G. When the street service is installed separately from the yard service a copper disk shall be installed on the yard side of the curb valve per the manufactures recommendations as approved by the Engineer or authorized representative.

H. Existing curb boxes shall be completely removed.

3. Construct the service pipe with at least 5 feet of cover unless Engineer or authorized representative requires additional depth.

4. Make all service connections, and transfers. Maintain and protect, at no additional cost, existing service connections requiring transfer, but not shown on the plans, until reconnection or disposal.

5. If relocating a portion of water service, shut down the water service by method approved by the Engineer or authorized representative.

6. Service lines entry points into the structure shall be sealed with hydraulic cement or mastic putty and oakum to prevent groundwater infiltration. For ductile iron pipe services, link seals should be used as the preferred method.

d. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	*Pay Unit*
Water Service, 2 inch	Each
Water Service, 1 ¼ inch	Each
Copper Water Service Pipe, 2 inch	Foot
Copper Water Service Pipe, 1 ¼ inch	Foot
Copper Water Service Pipe, 3/4 inch	Foot
Meter Box	Each
Corporation Stop Shutoff	Each

The Contractor shall be paid his unit price for **Water Service, _ inch** for each water service of the diameter specified actually installed on the proposed water main and reconnected to the existing yard service. The item shall include earth excavation; disinfection; tapping the water main; furnishing and installing the service saddle, corporation stop, new curb stop, curb stop box, and any other required fittings; connecting the proposed street service to the existing yard service; fully removing and disposing of the existing curb box; providing, placing, and compacting backfill and any other miscellaneous materials, equipment and work necessary for the installation of the service connection of the diameter specified from the proposed water main to the existing curb stop. This item shall include everything except for furnishing and installing the new service pipe and meter box or meter vault if required. Surface removals and restoration shall be limited to the areas depicted on the plans and shall be paid separately under associated pay items.

The Contractor shall be paid his unit price for **Copper Water Service Pipe, _ inch** for each linear foot actually furnished and installed, as measured from the water main to the curb stop.

The Contractor shall be paid his unit price for **Meter Box** for each Meter Box actually furnished and installed.

The Contractor shall be paid his unit price for **Corporation Stop Shutoff** for each existing corporation stop that is actually shutoff at the existing water main. Item includes excavation, backfilling, operating the existing curb stop to the closed position, and disconnecting service line from the corporation stop. Pay item only to be used if directed by the City. Pay item not to be used to correct damage caused by the Contractor.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

COATING OF GALVANIZED LIGHTING, SIGNAL, SIGN, AND MISCELLANEOUS SUPPORT STRUCTURES

a. Description. This work consists of furnishing all labor, equipment, and material required to coat galvanized structural highway appurtenances (light standards, traffic signal mast arm, strain poles, etc.) as specified in the contract documents and subsection 716 of the Standard Specifications for Construction except as modified herein.

b. Material. Provide a liquid or powder coating system as described below or as approved by the Engineer.

1. Coating System.

A. Provide a powder coating system with an exterior grade polyester, polyurethane, or fluoropolymer top coat; or

B. Provide a liquid coating system with an aliphatic polyurethane, polyaspartic, polysiloxane, or fluoropolymer top coat.

2. Provide top coat dry film thickness per paint manufacturer's specifications or a minimum 2 mils, whichever is greater.

3. Selected top coat must meet or exceed the requirements of *American Architectural Manufacturers Association* (AAMA) *2604*.

4. Use a tie coat to promote adhesion over galvanized surfaces, if recommended by the coating manufacturer. Apply tie coat by method and thickness as recommended by the coating manufacturer.

5. Provide top coat color per plan note.

6. Provide the coating manufacturer's recommended touch-up coating as required.

The coating manufacturer must furnish certification and test results for the top coat to the Engineer to verify that the material complies with *AAMA 2604*. If the coating manufacturer also recommends a tie coat for galvanized surfaces, submit tie coat product information to the Engineer, including tie coat application method and recommended thickness.

Fabrication plant must be certified by the *American Institute of Steel Construction* (AISC) *Sophisticated Paint Endorsement* or *Society for Protective Coatings* (SSPC)-*QP 3* or *Certification Standard for Shop Application of Complex Protective Coating Systems* if applying liquid coating system. Fabrication plant must be certified by the *Powder Coating Institute* (PCI)-3000 if applying powder coating system.

c. Surface Preparation. Perform surface preparation in accordance with subsection 716.03 of the Standard Specifications for Construction.

d. Coating Process for Galvanized Steel. Provide the liquid or powder coating system per the paint manufacturer's recommendations, except ensure conditions for coating are in accordance with subsection 915.04 of the Standard Specifications for Construction unless the manufacturer recommends more stringent conditions. Out gas forgiving additive in compliance with AAMA 2604 is permitted.

The powder coating applicator must carry out a preliminary test to establish whether out-gassing from the galvanizing is likely by testing parts where the zinc is thickest. Ensure the galvanized components are heated to a temperature at least 55 degrees Fahrenheit (F) higher than the coating curing temperature as provided by the coating manufacturer. Ensure the temperature is measured at the hottest point across the object during tests. If the substrate cannot be satisfactorily degassed sufficiently to minimize further out-gassing during baking, then ensure a specially formulated anti-gassing quality powder coating, or an anti-bubbling additive as per the manufacturer's recommendations, is used to minimize out-gassing.

Apply the paint system per paint manufacturer specifications including strict adherence to curing temperature and time except where the requirements listed in section 716 of the Standard Specifications for Construction are more stringent.

e. Construction. Ensure extreme care is exercised in handling the coated components in the shop, during shipping, and erecting of the structural highway appurtenances. Ensure coated pieces are not moved or handled until sufficient cure time has elapsed to ensure no damage is done to the coating. Ensure the coated components are insulated from the binding chains by softeners approved by the Engineer. Pad hooks and slings used to hoist steel. Space structural highway appurtenances in such a way that no rubbing will occur that may damage the coating during shipment and storage. Store the components on padded pallets at the job site, or by other means approved by the Engineer, so that the pieces do not rest on the ground and so that the components do not fall or rest on each other. Provide all shipping and storage details to the Engineer and ensure they are approved prior to shipment of the structural highway appurtenance.

Ensure shop and field repairs of coating are done according to coating supplier's recommendations except where the requirements listed in this specification are more stringent. Submit all written procedures for shop and field repairs including the coating of nuts, bolts, and washers for approval to the Engineer prior to coating. Do not begin coating until approval is received from the Engineer. Repair or recoat surfaces which will be inaccessible for coating after erection prior to erection. When the erection work has been completed, including all connections, prepare the steel for repairs. All repairs must be completed without additional cost to the Department.

f. Measurement and Payment. The completed work, as described, will be included with the pay item of the item to be coated and listed on the plans, and not paid for separately. Coating includes the cost of surface preparation, applying the tie coating, applying the complete coating system, stenciling, applying approved sealants, and shop and field repairing the complete coating system. Galvanizing and repair of damaged galvanized surfaces is included in the pay item for furnishing the galvanized component.

CITY OF KALAMAZOO
SPECIAL PROVISION
FOR
TRAFFIC SIGNAL CONTROLLER ATC TYPE

a. Description. This work consists of furnishing, delivering, and installing a traffic signal controller, *ATC* type.

This work includes furnishing and delivering the traffic signal controller. This work includes installation of the traffic signal controller, and accessories required to provide the traffic signal control operations as shown on the plans, in accordance with the *MMUTCD* and this special provision.

b. Material. Provide materials meeting the requirements in sections 918 and 921 of the Standard Specifications for Construction and this special provision.

1. Controller. This special provision defines the minimum acceptable requirements for an ATC type traffic signal controller.

A. Enclosure. The controller shall be compact so as to fit in limited cabinet space.

(1) The external dimensions shall not be larger than 8.5” x 15.2 ¼” x 6.375” (H x W x D).

(2) The top and bottom of the chassis shall be made from extruded aluminum and include an integral handle on the back for easy transport.

(3) The sides shall be constructed of injection molded polycarbonate.

(4) The model, serial number, and program information shall be displayed on the outside of the controller.

B. Electronics.

(1) The electronics shall be modular in design and shall consist of vertical circuit boards. Horizontal circuit boards shall not be acceptable.

(2) In the interest of reliability, no sockets shall be used for any electronic device. All devices shall be directly soldered to the printed circuit board. Surface mount parts shall be used for the majority of the electronic components in the controller.

(3) A built-in, high-efficiency switching power supply shall generate the primary, +5VDC internal voltage, an isolated +24VDC for internal and external use, VSTANDBY, POWERUP and POWERDOWN signals. All voltages shall be regulated.

(4) The 120 or 220VAC fuse shall be mounted on the front of the controller. Protection for the 24VDC supply shall be provided by a resettable electronic fuse.

(5) All printed circuit boards shall meet the requirements of the NEMA Standard plus the following requirements to enhance reliability.

(a) Both sides of the printed circuit board shall be covered with solder mask material.

(b) The circuit reference designation for all components and the polarity of all polarized capacitors and two-leaded diodes shall be clearly marked adjacent to the component. Pin 1 for all integrated circuit packages shall be designated on all printed circuit boards.

(c) All printed circuit board assemblies shall be coated on both sides with clear moisture-proof and fungus-proof sealant.

(6) Timing of the controller application shall be derived from the AC power line.

(7) To facilitate the transfer of user-programmed data from one controller to another, a data-key receptacle for using a separate 2070-style, serial flash memory device shall be an available hardware option. In addition, two USB sockets and one SD Card socket shall be provided for memory devices that can be used for data transfer. These data transfer devices shall be easily removable and directly accessible from the outside of the controller. The controller will not require this data-key, USB memory device, or SD Card to be present for proper operation.

(8) All controller software shall be stored in Flash Memory devices. The controller software shall be easily updated without the removal of any memory device from the controller. The use of removable PROMS or EPROMS from the controller shall not be acceptable. The controller shall include an option that allows updating software using a Windows based computer, a USB memory device, or an SD card.

C. ATC Engine Board.

(1) The controller shall include an ATC engine board compliant to ATC standards 05.2b and 06.25.

(2) The engine board shall include a PowerPC 83XX family processor with QUICC engine.

(3) The engine board shall have a minimum of the following memory.

(a) 128 Mbytes of DDR2 DRAM memory used for application and OS program execution.

(b) 64 Mbytes of FLASH memory used for storage of OS Software and user applications.

(c) 2 MB of SRAM memory used for non-volatile parameter storage.

(4) The engine board shall provide the seven ATC serial ports, Ethernet, USB and all other control signal required by the ATC standard.

(5) The operating system shall be Linux 2.6.35 or later.

D. Front Panel.

(1) The front of the controller shall consist of a panel for the display, keyboard and connectors for all necessary user connections. The front panel shall be available in touch (Graphic) or non-touch (Classic) screen models.

(2) The display shall be a seven-inch (7”), color, TFT (Thin Film Transistor) LCD (Liquid Crystal Display) with high brightness. It shall be readable in direct sunlight. The display will perform over the NEMA temperature range and shall have a resolution of 800 X 480.

(3) The touch screen shall have an 18-bit color depth. The luminous intensity shall be a minimum of 800 nits. The display shall include an industrial, resistive touch screen that can be operated with gloved hands. The touch screen and display shall not be affected by condensation or water drops.

(4) Front-panel operator inputs shall be via touch screen or by clearly labeled elastomeric keypad. These shall include a 10-digit numeric keypad, Main and Sub keys, toggle keys, special function and enter keys, six function keys, status and help keys and a large four-direction cursor control key.

(5) The front panel shall include a built-in speaker for enhanced controller audio feedback.

(6) The front panel shall include a tri-color status LED.

E. Ethernet Ports.

(1) The controller shall have the capability of supporting Ethernet communications, using TCP/IP communications protocols.

(2) The controller shall provide four front-panel Ethernet ports.

(3) Two of the ports shall be connected to Ethernet switch ENET1 and the other two shall be connected to Ethernet switch ENET2.

F. USB Ports.

(1) The controller shall provide two USB 2.0 ports.

(2) USB ports shall be used for USB thumb drives to update software, upload or download configuration or uploading logged data.

G. Connectors.

(1) All non-optional interface connectors shall be accessible from the front of the controller in the NEMA Configured Controller models. Configurations shall be offered to accommodate different versions, as seen below.

(a) NEMA TS2 Type 1

(b) NEMA TS2 Type 2

(c) NEMA TS1

(2) The D connector shall be a 61 pin AMP 205842-1.

(3) To facilitate special applications the controller shall have the capability of assignment of any input or output function to any input or output pin respectively on the interface connectors, with the exception of Flashing Monitor, Controller Voltage Monitor, AC+, AC-, Chassis Ground, 24VDC, Logic Ground and TS2 Mode bits.

(4) The controller shall as a minimum have the following communication ports.

(a) Port 1 SDLC for communications with other devices in the cabinet

(b) Port 2 serial port for systems communications

(c) Console serial port for local communications

(d) Ports on ATC-2070 communication slots

(5) Serial communications shall operate from 1200 to 115.2 K baud.

(6) The controller shall provide one ATC-2070 Type communications slot that will allow ATC 2070 type modules to be inserted.

H. Controller Software. Provide a controller local software with each ATC controller from the following list. Confirm the appropriate software prior to ordering. No additional payment will be made based on the software provided.

(1) Econolite EOS, version 03.01.23 or the latest version as approved by the engineer.

(2) Econolite ASC3/LX, version 32.65.30 or the latest version as approved by the engineer.

(3) Approved equal. Requests to use an alternate controller local software will not be justification for project delays.

2. Packing and Marking. Ensure each controller is packed separately in such a manner that there will be no injury or defacement to the controller during transportation to the point of destination, unless otherwise specified in the contract. Ensure each carton is legibly marked with the controller description, purchase order number, and vendors name.

3. Warranty. Provide materials with a manufacturer's warranty, transferable to the agency, that the supplied materials are free from all defects in materials and workmanship.

Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, as shown on the plans and as directed by the Engineer.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Controller, ATC Type, Graphic	Each
Controller, ATC Type, Classic	Each
Controller, ATC Type, Rem	Each

1. **Controller, ATC Type, Graphic** includes:

A. All labor, equipment, and materials required to install the traffic signal controller, and accessories required to provide the traffic signal control operation as shown on the plans and in accordance with the *MMUTCD* and this special provision.

B. Furnishing and delivering the controller to the maintaining agency for cabinet setup.

C. Transporting the controller from the maintaining agency to the job site for installation.

2. **Controller, ATC Type, Classic** includes:

A. All labor, equipment, and materials required to install the traffic signal controller, and accessories required to provide the traffic signal control operation as shown on the plans and in accordance with the *MMUTCD* and this special provision.

B. Furnishing and delivering the controller to the maintaining agency for cabinet setup.

C. Transporting the controller from the maintaining agency to the job site for installation.

3. **Controller, ATC Type, Rem** includes all labor, equipment, and materials required to remove an existing traffic signal controller from an existing cabinet.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

CONTROLLER CABINET, MODIFIED

Wightman/PAD 10/03/2022

a. Description. This work consists of furnishing, delivering, and installing a traffic signal cabinet, *NEMA* type and includes removals of existing controller cabinet.

This work includes furnishing and delivering the cabinet to the maintaining agency for cabinet setup. This work includes transporting the cabinet from the maintaining agency to the job site for installation. This work includes installation of the cabinet, and accessories required to provide the traffic signal control operations as shown on the plans, in accordance with the *MMUTCD* and this special provision. As applicable this work includes mounting brackets and hardware, conduit risers, wiring, connectors, grounding, terminating signal wiring, and all appurtenant materials required to ensure a complete installation.

b. Material. Provide materials meeting the requirements in sections 918 and 921 of the Standard Specifications for Construction and this special provision.

1. Cabinet. This special provision defines the minimum acceptable requirements for a series of cabinets that differ in size, to house the controller unit (CU) and related devices. Provide the base mounted size 6 cabinet unless the plans indicate otherwise.

A. Cabinet Dimensions. Outside dimensions are as shown in Table 1. These dimensions are outside dimensions exclusive of hinges, handles, overhang(s), vent housing, and adapters. Cabinet heights are measured to the lowest point of the top surface of the cabinet. Ensure the combined overhangs of the four sides of the cabinet does not exceed 4 inches.

Table 1: Minimum Outside Dimensions

Size	Height (inches)	Width (inches)	Depth (inches)
M30	51	30	16
M36	51	36	16
6	56	44	25.5
M30-ITS	61	30	16
6-ITS	66	44	25.5

B. Cabinet Types and Mountings.

(1) Base Mounted (Size 6 and 6-ITS). Ensure the size 6 and 6-ITS cabinet can be constructed so that it can be mounted on a 30 inch by 48 inch foundation. Anchor bolt mounting provisions for four bolts on 40¾ inch centers (side-to-side) on 18½ inch

centers (front-to-back). Include one base adaptor, 15 inches in height, with the same dimensions and bolt pattern as the cabinet. Provide eight nuts and eight washers with each size 6 and 6-ITS cabinet.

(2) Pole Mounted/Base Mounted (M30 and M30-ITS). Ensure cabinets intended for side of pole mounting are provided with any necessary adapter, inclusive of steel banding, to permit mounting to a 4½ inch or larger diameter pole. Ensure the adapter accommodates lag bolts up to 3/8 inch and steel banding up to 1 inch wide. Ensure mounting points are provided at or near the top and bottom of the cabinet. Ensure the adapter has provisions for two holes spaced horizontally, which will have a center-to-center distance of 3½ inches. Furnish cabinets without conduit holes. In addition, ensure the cabinet is provided with a removable bottom to enable it to be pole or base mounted.

(3) Base Mounted (M36). Ensure the M36 cabinet is constructed so that it can be mounted on a 24 inch by 42 inch foundation. Ensure anchor bolt mounting provisions are dimensioned for two bolts on 18 inch centers (side to side).

(4) Anchor Bolts. Provide anchor bolts for base mounted cabinets which are 3/4 inch in diameter by 42 inches long which includes a 90-degree bend with a 3-inch leg. Ensure the long leg is threaded for at least 3 inches with a 3/4 inch Unified Coarse Thread (UNC) -10 thread. Ensure anchor bolts are steel with a hot-dipped galvanize.AISI 300 Series.

C. Materials. Construct the traffic control cabinet of aluminum . Ensure the aluminum material is a minimum of 1/8 inch alloy sheet, *ASTM B 209*, *5052-H32* or equivalent.

D. Finish and Surface Preparation. Paint and prepare cabinets as specified herein.

(1) The surface of the cabinet must be suitably prepared Aluminum SSPC or approved equal prior to painting, to avoid paint peeling.

(2) Interior surface must be painted white. Ensure the interior of the controller cabinet is finished with a durable two coat white paint having a total dry film thickness of not less than 0.75 mils.

(3) Ensure the exterior of the controller cabinet and all mounting attachments are finished with a durable and weather-resistant protective coating having a total dry film thickness of not less than 1.5 mils. Ensure the final coat is aluminum in color, gives complete coverage, and must be at least 0.75 mil in thickness.

(4) Repaint any scratched or damaged surface area. Ensure the final repair coat is aluminum in color, yields complete coverage, and must be at least 0.75 mil in thickness.

E. Top Surface Construction. Ensure the cabinet is manufactured to prevent the accumulation of water on its top surface.

F. Doors.

(1) Main Cabinet Door. Ensure the cabinet has a main door which permits access

to all equipment within the cabinet. Ensure doors are hinged on the right side of the cabinet as viewed from the outside facing the cabinet door opening. Ensure the door has a handle of one piece construction and swings away from the locking mechanism.

(2) Hinges. Ensure all cabinet doors incorporate a piano type hinge utilizing stainless steel hinge pins.

(3) Door Stop. Ensure the cabinet door is provided with a door stop which holds the door open at 90 degrees and at 180 degrees (±20 degrees at each stop).

(4) Latches and Locking Mechanism.

(a) Ensure all cabinets incorporate a main door lock, Corbin No. 15481RS, Pelco (Type II) SM-1025 or equivalent, constructed of nonferrous or stainless materials, which operates with a Traffic Industry conventional #2 key, Corbin No. 1R6380 or Pelco (Type II) SM-0198-2 or equivalent. Ensure a minimum of two keys are included for the main door of each cabinet.

(b) Ensure the cabinet door(s) is provided with a three-point latch. Ensure the top and bottom has rollers to secure the door in a closed position.

(c) When in the locked position, ensure the lock prevents the movement of the three-point latching mechanism.

(d) Ensure the cabinets provide with a means of externally padlocking the latching mechanism. Ensure a minimum of 3/8 inch diameter lock shackle is accommodated.

(5) Door Opening. Ensure the main door opening of all cabinets is at least 80 percent of the area of the cabinet side which the door closes, exclusive of the area of plenums.

(6) Switch Compartment.

(a) Mount a hinged switch compartment door to the outside of the main cabinet door. Ensure the door permits access to a switch panel but does not allow access to exposed electrical terminals or other equipment within the cabinet.

(b) Ensure the switch compartment with the door closed has minimum internal dimensions of 3½ inches high, 7½ inches wide, and 2 inches deep. Additionally, ensure the volume is not less than 70 cubic inches.

(c) Ensure switch compartment doors are equipped with a lock, which can be operated by a police key, Corbin Type Blank 04266 or Pelco Type SM-0200 long keys, or equivalent. Ensure a minimum of two keys are included for the switch compartment of each cabinet.

(7) Intelligent Transportation System (ITS) Compartment.

(a) M30-ITS and 6-ITS cabinets must include a hinged compartment door mounted to the outside front of the cabinet, above the main door. The door must

permit access to shelf mounted ITS devices and electrical power components to power these devices.

(b) To allow for the ITS and power components, the ITS compartment door will have a minimum opening size of 8 inches high by 27 inches wide for the M30-ITS cabinet and 8 inches high by 41 inches wide for the 6-ITS cabinet. The depth of the compartment will be the full depth of the cabinet.

(c) The ITS compartment door is to be equipped with a Type 2 lock, cut for the Traffic Industry standard #1 key. A minimum of two keys must be included for the ITS compartment.

(d) Accommodation will be made to allow free air movement from the ITS compartment to the controller compartment.

(e) The ITS compartment will include U-channels mounted to the sides of the compartment for future mounting of shelves and/or Deutsches Institut für Normung (DIN) rail(s). Four U-channels, two on each side, must run vertically up the entire height of the compartment. Two additional U-channels must run horizontally across the entire back of the compartment.

(f) Run flexible 1½ inch innerduct from the dedicated ITS conduit at the bottom of the cabinet to the ITS compartment. Run the flexible innerduct up the back-left corner inside the main compartment of the cabinet into the ITS compartment. Install the flexible innerduct in such a way that wires and cables can be run into the ITS compartment from outside the cabinet without accessing the main compartment of the cabinet.

G. Shelves.

(1) Ensure the cabinet is provided with two shelves for supporting the control equipment.

(2) Ensure the shelves are at least 10 inches in depth. Shelf height must leave a minimum of 2 inches of clear space between the top of the CU and the bottom horizontal surface of the shelf without blocking access to the back panel.

(3) Ensure all cabinets have a provision for positioning shelves to within 12 inches of the bottom of the cabinet and to within 6 inches of the top of the cabinet in increments not more than 1/2 inch.

H. Cabinet Risers.

(1) Ensure the M30, M30-ITS (when specified as base mount), M36, the Size 6 and 6-ITS are provided with a 15 inch high cabinet riser.

(2) Ensure the riser matches the mounting base of the cabinet and is provided with anchor bolt holes on the top and bottom of the risers.

(3) Ensure the risers come in two parts for ease of assembly.

I. Ventilation System. Ensure all cabinets incorporate a ventilation system to provide for the circulation of external air through the enclosure to remove excess heat, fumes, or vapors. Ensure each cabinet is equipped with an electric fan with a capacity of at least 100 cubic feet of air per minute.

(1) Fan. Ensure the fan on all aluminum door cabinets is installed so that it operates in the filtered incoming air stream so as not to create a negative pressure within the cabinet relative to its outside environment. Ensure all fans are equipped with a guard which inhibits a user from making contact with the blades of the fan.

(2) Fan Controls.

(a) Ensure all cabinets equipped with a fan has a device to control the operation of the fan.

(b) Ensure the device switch-on point is manually adjustable at least in the range from 80 degrees Fahrenheit (F) to 120 degrees F.

(c) Ensure the device has a differential between its switch-on point and its switch-off point. Ensure this differential is not be greater than 25 degrees F.

(d) Ensure the device is placed in the inside of the top of the cabinet not lower than 6 inches from the top of the cabinet.

(3) Filter. Ensure the cabinet is equipped with a device to filter the incoming air. Ensure the cabinets are provided with louvered vents in the main door with a replaceable air filter having a width of 16 inches, a height of 12 inches, and a thickness of 1 inch.

J. Terminal Facility. This special provision defines the minimum acceptable requirements for terminal facilities to interconnect the related devices within a traffic control cabinet.

(1) Mechanical Construction. Ensure the terminal facility is in accordance with the following mechanical requirements.

(a) Terminal Identification.

(i) Ensure all terminals are permanently identified in accordance with the cabinet wiring diagram. Ensure where through-panel terminal blocks are used, both sides of the panel have the terminals properly identified with the terminal position number.

(ii) Ensure identification is permanently attached and close as possible to the terminal strip and is not affixed to any part which is easily removable from the terminal block panel.

(iii) Ensure each input or output terminated on a terminal block is identified on the front of the panel by position number and function terminology (e.g., Ph 1 Red, Ph 2 Hold, etc.).

(iv) Ensure the same identification is used consistently on the cabinet wiring diagram.

(b) Component Identification. Ensure all components which make up the basic terminal facility are permanently identified in accordance with the cabinet wiring diagram. The following components are considered part of the basic terminal facility:

(i) Load Switch Sockets;

(ii) Flash Transfer Relay Sockets;

(iii) Flasher Socket;

(iv) Main and Auxiliary Circuit Breakers;

(v) Radio Interference Suppressor and Surge Protector;

(vi) Solid State Signal Power Relay; and

(vii) Power Terminal Bus Bars.

Ensure where through-panel components are used, both sides of the panel have the components properly identified by relative symbols (e.g., FRI, LS1, etc.).

Ensure identification is permanently attached and as close to the component as possible and is not affixed to any part which is easily removable from the panel.

Ensure each component is identified on the front of the panel by symbol and function terminology (e.g., LF1 Filter, BR1 Signal Bus, etc.).

(c) Load Switch and Flasher Support.

(i) Design and construct load switch and flasher bases to receive all such devices which may be manufactured to the maximum size requirements permitted under the *NEMA Standards Publication*.

(ii) Ensure all support(s) are provided so that, at a minimum, it(they) is(are) supporting the flasher and load switch of the maximum size at some point(s) between 3 inches and 7 inches from the panel.

(iii) Ensure at least 90 percent of the area beneath the load switch or flasher is open to allow for the free flow of air across the load switches or flasher. Ensure there is no obstruction within 1 inch above or below the units within the open area.

(d) Load Switch, Flasher, and Flasher Transfer Positions.

(i) Ensure wired load switch, flasher, and flash transfer relay sockets are provided in the quantities listed in Table 2.

Table 2: Load Switch, Flasher, and Flash Transfer Socket Relay Quantities

Configuration	Load Switch	Flasher	Flash Transfer
A2	8	1	4
A5	12	1	6
A16	16	1	6

(ii) Ensure the flasher socket is wired for a Type 3 solid state flasher in accordance with *Section 8 of NEMA Standards Publication*.

(iii) Ensure flashing of even numbered load switch output indications are placed on one circuit and flashing for odd numbered load switch output indications are placed on the other circuit. Ensure it is possible to flash either the amber or red indication on any load switch outputs. Ensure it is possible to easily change the flash indication from the front side of the panel using simple tools without the need to unsolder or re-solder connections.

(iv) Ensure the load switch sockets are wired for triple-signal load switches in accordance with *Section 5 of NEMA Standards Publication TS 2* for Type 2 CUs. Ensure all load switch driver outputs coming out of the CU are on separate terminal points from the respective inputs to the load switches. Ensure these separate termination points are bussed for normal operation. Ensure all load switch outputs are on separate points from the respective inputs to the malfunction management unit (MMU) inputs. Ensure these separate points are bussed for normal operation.

(v) Ensure load switch sockets for the A2 configuration are oriented in a single row of eight. Ensure socket positions one thru four are for phase one thru four vehicles, respectively. Ensure socket positions five thru eight are for phases one thru four pedestrians, respectively.

(vi) Ensure load switch sockets for the A5 configuration are oriented in a single row of 12. Ensure socket positions one thru eight are for phase one thru eight vehicles, respectively. Ensure socket positions 9 thru 12 are for phases 2, 4, 6, and 8 pedestrians, respectively.

(vii)Ensure load switch sockets for the A16 configuration are oriented in two rows of eight positions each. Ensure the top row includes socket positions one thru eight and is for phase one thru eight vehicles respectively. Ensure the lower row includes socket positions 9, 10, 11, and 12 for overlaps A thru D, respectively, and are located below socket positions 1, 3, 5, and 7 respectively. Ensure socket positions 13, 14, 15, and 16 in the lower row are below and to the right of socket position 8, and is for pedestrian phases 2, 4, 6, and 8 respectively.

(e) Terminal Blocks. Ensure terminal blocks have mechanical characteristics to properly support the wiring connected without warping the terminal block. Ensure all materials including screws and threaded portions used in terminals and terminal blocks are stainless steel.

(i) Field Terminal Blocks. Include field terminal blocks for all inputs and outputs for a fully expanded CU. Ensure these blocks are either single terminal type with through-panel connection on the rear side of the mounting panel or double binder head screw terminals. Ensure either type of terminal block uses the correct ampacity for the application. Minimum acceptable ratings are 30 ampere (A), 300 volt (V), with 10 - 32 binder head screws.

(ii) Control Terminal Blocks. Include control terminal blocks for inputs and outputs of the CU, MMU, flash transfer relays, load switches, etc. Ensure these blocks are either single terminal type with through-panel connections or double binder head screw terminals. Ensure either type of terminal block uses the correct ampacity for the application. Minimum acceptable ratings are 15A, 250V, with 6-32 x 1/4-inch pan or binder screws.

Ensure the control terminal block wiring provides groupings of functions based on probable interconnect (bussing) for normal operation rather than based on the source of the wiring (e.g., CU, MMU, etc.).

(iii) Detector Terminal Blocks. Include detector terminal blocks for loop and push button inputs. Ensure these blocks are either single terminal type with through-panel connections or double binder head screw terminals. Ensure either terminal block is of the correct ampacity for the application. Minimum acceptable ratings are 20A, 250V with 8 - 32 pan or binder screws.

(f) CU and MMU Harnesses.

(i) Ensure the CU and MMU harnesses is neatly arranged and provided with the flexibility for the connectors to reach at least 40 inches from the top of the terminal block panel which must be mounted directly below the CU shelf. Ensure the harness connectors do not have any sharp edges and the stress relief attachment screws do not extend greater than 1/4 inch beyond the stress relief.

(ii) Ensure terminal positions are provided, completely wired and neatly arranged, providing access to all inputs and outputs listed in the CU specification. Ensure all *NEMA Standards Publication* functions of the CU for the configuration selected are terminated, except those designated by *NEMA* as spares, reserved, no connection, and manufacturer's use need not be installed in the harness.

(iii) Ensure terminal positions are provided, completely wired and neatly arranged, providing access to inputs and outputs in the MMU. Ensure all MMU input is terminated. Ensure provisions are made to terminate any unused red monitoring inputs. Ensure type select and port one disable inputs are terminated.

(iv) Provide a D connector for connection to the CU. The connector will be of the style for the controller approved for the project. The connector terminal strip must be attached via channel nuts to the upper left side of the cabinet.

(v) Ensure the MMU harness is configured for a 16 channel MMU operating in the type 12 mode. Ensure the MMU harness is configured as specified in Table 3.

Table 3: MMU Harness Configuration

Configuration	Load Switch	MMU
A2	8	12 Channel
A5	12	12 Channel
A16	16	12 Channel

(g) Power Distribution. Supply the following equipment as part of the power distribution panel:

(i) Main Circuit Breaker;

(ii) Six Auxiliary Circuit Breakers;

(iii) Solid State Signal Power Relay;

(iv) Primary and Secondary Surge Protector;

(v) Neutral Bus Bar;

(vi) Equipment Ground Bus Bar;

(vii) AC+ Power (Filtered) Bus Bar;

(viii) AC+ Power (Unfiltered) Bus Bar.

(h) The following equipment must be supplied as part of the ITS compartment power panel:

(i) Three Auxiliary Circuit Breakers;

(ii) Neutral Bus Bar;

(iii) Equipment Ground Bus Bar.

(2) Electrical Requirements. Ensure the terminal facility conforms to the following electrical requirements:

(a) Power Distribution. Ensure the terminal facility operates properly when supplied with single-phase alternating current (AC) power [95-135V, 57-63 hertz (Hz)] when non-ITS cabinets and 240V when an ITS type cabinet. Ensure all breakers and grounding devices are wired in accordance with the *NEC* and the *Michigan Electrical Code*.

(i) Circuit Breakers. Ensure provisions are made for mounting and wiring up to nine circuit breakers in the terminal facility. Ensure a quantity of seven

circuit breakers are provided with ampacities as specified in Table 4.

Table 4: Circuit Breaker Ampacity (in A)

Configuration	Main	Vehicle Load Switch	Pedestrian Load Switch	Flasher	Miscellaneous	Channel Reds	Illuminated Sign
A2	30	10	10	10	10	10	20
A5	30	10	10	10	10	10	20
A16	30	10	10	10	10	10	20

The M30-ITS and the 6-ITS cabinets will include an additional 30A circuit breaker mounted on the main cabinet power panel, utilizing a single phase of the AC power to power the ITS compartment devices. Two 15A and one 10A circuit breakers will be provided in the ITS compartment, wired to the load side of the 30A breaker.

Ensure the main circuit breaker is wired to protect the entire facility and is identified as the “MAIN” breaker. Ensure the Vehicle Load Switch breaker and the Pedestrian Load Switch breaker are fed by the load side of the bus relay and provides power to the vehicle and pedestrian load switches, respectively. Ensure the Flasher breaker has the flasher connected to its load side. Ensure the miscellaneous breaker has the cabinet fan, light, and door mounted duplex receptacle connected to its load side. Ensure the Channel Red breaker is connected to the input to the MMU for the Red enable and cabinet control relay coils. Ensure the Illuminated Sign breaker is available to power auxiliary devices such as illuminated signs. Ensure the breaker for the ITS compartment (if used) will be fed by a separate phase connected to the power disconnect. Ensure the circuit breakers are capable of manual operation with markings to indicate rating and whether it is in the open or closed position. Ensure Square D series QOB circuit breakers are used and mounted on QON3B triple position breaker blocks.

Ensure a four pole fuse holder with screw terminals for connecting individual illuminated sign loads is provided and wired to the load side of Illuminated Sign breaker.

(ii) Cabinet Surge Protection. Ensure the power panel has devices to provide both primary and secondary surge protection devices. Ensure the Line In, Neutral In and Ground leads of the primary device are to be kept as short as possible (18 inches maximum), with no sharp bends and must not be bundled with other conductors.

Ensure the primary surge protection device (SPD) has two separate hot legs. For the non-ITS cabinets, ensure both legs of the SPD are connected to the load side of the main circuit breaker. For the M30-ITS and the 6-ITS cabinets, the second leg must be connected to the load side of the main circuit breaker for the ITS compartment. Ensure the primary SPD is connected in parallel to the load and have a surge capacity of 160 kiloamperes (kA) per phase or greater. Ensure the let through voltage measured 6 inches outside the unit does not exceed 430V = 3kA 8/20 microseconds(u/s) pulse and 650V = 10kA

8/20 u/s pulse. Ensure modes protected are Line to Ground, Line to Neutral, Line to Line and Neutral to Ground. Ensure the SPD provides Green LED indications that protection is operational and Red LED indications that a fault has occurred. Ensure in addition, an audible alarm sounds indicating a fault has occurred. Ensure there is a set of normally open and normally closed contacts available for remote monitoring of the SPD. Ensure the SPD is no larger than 9.3 inches wide by 3 inches high by 4.93 inches deep. Ensure the SPD is mounted on the lower right hand side of the cabinet and easily accessible for replacement.

Ensure the secondary SPD is connected to the load side of the main circuit breaker and its output will be used to supply AC power the CU, MMU, and cabinet electronics power strip. Ensure the surge current capacity is 50kA or greater, with the unit connected in series to the load. Ensure the secondary SPD is a 5-stage hybrid design with integrated filter with series load current of 12A. Ensure the let through voltage measured 6 inches outside the unit does not exceed 260V = 2kA 8/20 u/s pulse and 300V = 3kA 8/20 u/s pulse. Ensure modes protected are Line to Ground, Line to Neutral, and Neutral to Ground.

Ensure a gas tube device is installed on the load side of the main circuit breaker. Ensure it is possible to replace this device without interrupting power to the rest of the terminal facility. The M30-ITS and the 6-ITS cabinets must have a second gas tube device installed on the load side of the main circuit breaker feeding the ITS compartment. For the ITS cabinets, ensure that the ITS compartment includes a switched, surge protected, metal enclosed, outlet strip. This outlet strip is to provide a minimum 3,300 joule suppression rating and is wired to the load side of one of the 15A ITS compartment breakers. Ensure the outlet strip is mounted on the rails on the back of the cabinet.

(iii) Solid State Signal Power Relay. Ensure the terminal facility includes a single-pole, single-throw (SPST)-no signal power relay wired to provide power from the main circuit breaker and radio frequency interference (RFI) filter to the AC signal power bus bar and load switches. Ensure the solid-state relay is energized to provide power to the signal bus and have ampacity of 75A. Ensure it provides zero voltage switching from 47 – 63Hz. Ensure the signal power relay is mounted on a panel on the lower right side of the controller cabinet and easily accessible for replacement.

(iv) AC-Common Bus Bar. Terminate the AC-common (Neutral) on a solid metallic multi-terminal bus bar that will accept #4 - #16 American Wire Gage (AWG) copper conductors. Ensure this bus bar is insulated from the cabinet. Ensure separate wires are run from this bus bar to each unit or group of similar units in the terminal facility which requires AC-common connection. Ensure only one conductor is allowed in each termination position. Ensure a minimum of 24 open termination positions are available for field wiring common return connections.

(v) Equipment Ground Bus Bar. Terminate the equipment ground on a solid metallic multi-terminal bus bar that will accept #4 - #16 AWG copper conductors. Ensure this bus bar is connected to the cabinet. Ensure only one

conductor is allowed in each termination position. Ensure a minimum of 24 open termination positions are available for field wiring ground connections.

Ensure separate wires are run from this bus bar to each unit or group of similar units in the terminal facility which requires equipment ground connection.

(vi) In addition to the three breakers and surge protected outlet strip, ensure the upper ITS compartment includes: ground fault interrupter (GFI) outlet wired to the load side of one of the 15A breakers, a minimum 6 position ground bus, led lighting mounted above the air plenum above the door powered via a door switch and 10A breaker, and a minimum 12-inch-long piece of DIN rail mounted across the channels on the back of the cabinet.

(b) Conductors. Ensure all conductors used in the terminal facility wiring are #22 AWG, or larger, with a minimum of 19 strands. Ensure conductors terminated on the AC-common bus bar and safety ground bus bar are tinned and a minimum size of #16 AWG. Ensure the insulation has a minimum thickness of 10 mils and is nylon jacketed polyvinyl chloride or is irradiated cross-link polyvinyl chloride. Ensure conductors #8 AWG are UL Type THHN.

Ensure all conductors used in the terminal facility wiring are in accordance with the following color-code requirements:

(i) Ensure the AC-neutral conductor of a circuit is a continuous white color.

(ii) Ensure the equipment ground conductor of a circuit is a continuous green color or a continuous white color with one or more green stripes.

(iii) Ensure the AC ungrounded power conductor of a circuit is a continuous black color.

(iv) Ensure the low-level direct current (DC) (+24 or less) conductor of a circuit is a continuous blue color.

(v) Ensure other conductors, not conforming to one of the above, are any continuous color not defined above.

(c) Wiring (Power Distribution within the Facility).

(i) Ensure all terminal facility wiring is neat, firm, and routed, where practical, to minimize crosstalk and electrical interference. Do not use printed circuit boards to eliminate or reduce facility wiring. Do not use adhesive-backed means to support any wiring.

(ii) Ensure all terminal facility conductors are of sufficient size to carry the maximum current of the circuit or circuits they are provided for. Ensure they are sized based on the ampacity ratings per Table 5.

Table 5: Terminal Facility Conductor Size

AWG Wire Size	Ampacity Rating
#22	5A
#16	10A
#14	15A
#12	20A
#10	30A
# 8	50A
# 6	70A

(iii) Ensure the conductor feeding power from the main circuit breaker to the auxiliary breakers, solid state signal power relay, primary and secondary SPD terminal blocks, and AC signal power bus bar has an ampacity of 30A.

(iv) Ensure the conductor feeding power to the flasher socket has, as a minimum, an ampacity of 10A.

(v) Ensure the conductor feeding power to the signal power bus bar to each load switch socket has an ampacity of 10A.

(vi) Ensure the conductors feeding power from the load switch to the field signal terminals has an ampacity of 10A.

(vii) Ensure the conductors feeding power from the flasher socket to the flash transfer relay sockets, which feed flashing power to same, has an ampacity of 10A. The remaining wires to and from the flash transfer relay socket, which are in the circuit between the load switch socket and the field signal terminals, are covered in the previous paragraph.

(d) Control Circuits.

(i) Flash Transfer Control. Ensure the control circuit to the flash transfer relay sockets can provide flashing operation when the MMU or optional auxiliary equipment call for flash (e.g., police panel flash switch and maintenance panel). Ensure the flash transfer control also conforms to the following:

Ensure the flash transfer relay socket is wired so the coil of the relay(s) must be de-energized for flashing operation. Ensure the flash transfer relay sockets are near the load switches, flasher, and field signal terminals.

(ii) MMU Control. Ensure the MMU is wired to provide flashing operation when the fault relay de-energizes or if the MMU is disconnected. Ensure it also provides "Stop Time" to the CU when the fault relay de-energizes. Ensure the MMU is wired to provide an "External Start" signal to the CU upon the application of AC power to the MMU following a power interruption or upon initial turn-on.

(iii) Detector Rack. All cabinets must include a 20-channel detector rack

that meets *NEMA TS2- Section 5 specifications*. Ensure the detector rack accommodates 16 channels of vehicle detection and an additional 4 channels of pedestrian detection push button isolation. Ensure the bus interface unit (BIU) slot is in the first (furthest to the left) position in the detector rack. Ensure the 16 channels of vehicle detection are located immediately to the right of the BIU. Ensure the four channels of pedestrian detection are in the last (furthest to the right) slot positions. Ensure each cabinet includes one power supply for the detector rack that meets the *NEMA TS2-* specification for power supplies.

(3) Field Wire Terminal Locations. Ensure the terminal facility provides field wire terminals located in accordance with the following requirements:

(a) AC Service Hookup. Terminate incoming AC power service on the right side of the cabinet on the power distribution panel. Terminate the incoming AC power service using listed pressure connectors capable of accepting a #4 AWG conductor for the grounded, ungrounded, and equipment grounding conductors. Terminate the ungrounded conductor directly to the main circuit breaker. Terminate the neutral and equipment ground conductors directly to their respective bus bars. Ensure this service hookup meets *NEC* code, and the *Michigan Electrical Code*.

(b) Signal Hookup. Terminate signal wires on terminal blocks on the back of the cabinet at least 3 inches but not over 6 inches from the bottom of the cabinet. Locate the field terminal block for signal circuits a minimum of 4 inches below the load switches and angled up 30 to 45 degrees from vertical for ease of access. Ensure signal terminals are directly accessible from the front of the cabinet. Provide one terminal for each load switch output. Ensure each field terminal includes a SLU-35 or equivalent pressure connector that will allow multiple field conductors to be attached to a single output terminal. Ensure it is possible to terminate a minimum of 16 #14 AWG neutral leads on the signal neutral bar.

(c) Detector Panel. Terminate vehicle loop and pedestrian pushbutton inputs on terminal blocks on the left side of the cabinet at least 3 inches from the bottom of the cabinet. Provide a minimum of three terminals for each vehicle detector and four terminals for each pedestrian detector. Ensure the terminal block meets the specifications of the detector terminal blocks. Ensure the detector panel is wired completely to the detector rack, providing 20 channels total.

(4) Auxiliary Equipment.

(a) Ensure the terminal facility includes provisions for the following equipment in a panel accessible from a police door on the front of the cabinet.

(i) Signals On-Off Switch. Ensure a signals on-off switch is included, installed, and wired.

Ensure the switch and wiring energizes or de-energizes the solid-state signal power relay. Ensure the AC signal power is not routed through this switch. Label the switch "Signal-Off". Ensure when in the “Off” position, all signal field terminals are de-energized and the Red Enable input to the MMU is inactive.

(ii) Flash Normal Switch. Ensure a flash-normal switch is included.

Ensure when in the Flash position, the flash transfer relays and solid state signal power relay is de-energized, and power is removed from the MMU and CU, resulting in flash being displayed to traffic. Ensure neither AC signal power nor flashing power is routed through this switch. Ensure the switch is labeled "flash-normal".

Ensure when the switch is returned to the “Normal” position, the signals return to the initialization phase and begin cycling.

Ensure operation of the signal-off switch overrides this switch. That is, when in the "Off" position, the signal-off switch prevents flashing operation as called for by all flash control circuits.

(iii) Manual Control Cord and Switch. Install a manual control cord and auto-hand switch and wired in the police panel of the cabinet.

Ensure the switch and wiring energizes the "manual control enable" input to the CU and connects the manual control cord to the "interval advance" input to the CU. Label the switch "auto-hand".

(b) Maintenance Panel Options.

(i) Detector Test Switches. Provide a detector test push-button switch for each vehicle and pedestrian detector circuit in a panel on the inside of the front cabinet door. The A2 configuration requires eight test push-buttons for phases one thru four vehicle and pedestrian inputs. The A5 and A16 configurations require 12 test push-buttons for phases 1 thru 8 vehicle inputs and phases 2, 4, 6, and 8 pedestrian inputs.

Ensure the switch and wiring places an actuation for the respective vehicle or pedestrian phase when pushed. Label the switch(s) "call switch" and the phase # as well as whether it is vehicle or pedestrian (e.g., Ph 1 Veh, Ph 1 Ped, etc.).

(ii) Stop Time Switch. Provide a stop time switch in a panel on the inside of the front cabinet door. Ensure the switch and wiring provides three modes of operation which are:

14 Normal. Provides "Stop time" to the CU as required by the MMU.

15 Run. Prevents "Stop time" from being applied to the CU from other devices.

16 Stop. Applies "Stop time" to the CU. Ensure this switch is labeled "stop-run-normal".

(iii) Flash-Normal Switch. Provide a flash-normal switch in a panel on the inside of the front cabinet door.

Ensure the switch and wiring provides flashing operation as defined for police panel flash-normal switch except that it does not terminate power to the CU. Ensure provisions are provided so that this flash-normal switch operates as a CU power switch by removing a control terminal link. Label this switch "flash-normal".

(iv) Duplex Receptacle. Provide a duplex receptacle of a three-wire GFI type in a panel on the inside of the front cabinet door.

For the M30-ITS and 6-ITS cabinets provide a duplex receptacle of a three-wire GFI type in the ITS compartment on the right side, towards the front. The receptacle must be wired to one of the 15A circuit breakers in the ITS compartment.

(c) Miscellaneous Options.

(i) Cabinet Forced Air Heater. Provide a forced air heater for all cabinets, rated with at least 100 watt (W) for the M30 and M30 ITS cabinets, and 200W for all other configuration cabinets, completely wired and operational. Provide a temperature and humidity level controller to operate the heater. Ensure the temperature control has an adjustable set point from 32 to 95 degrees F. Ensure the humidity control has an adjustable set point from 50 to 90 percent relative humidity. Mount the heater below the bottom shelf and offset from the cabinet walls with air forced downward. Care must be taken to mount the heater clear of the field wiring.

(ii) Cabinet Lights. Install two LED lighting panels with a switch in the cabinet. Provide a door switch to activate the lights when the door is opened. Install one lighting panel above the top shelf and install the second to the bottom of the lower shelf's storage drawer. Each panel must provide at least 450 lumens of light and consume no more than 15W of power.

Wire the switches and lights to the miscellaneous circuit breaker.

Install one light socket in the upper right wall of the control cabinet and the second light socket on the left wall of the cabinet immediately below the lower shelf.

Install one LED light strip in the ITS compartment of M30-ITS and 6-ITS cabinets. Ensure the door switch activates the light when the door is opened.

(iii) Outlet Strips. Install a multiple outlet strip on the upper right side of the cabinet. Wire the outlet strip to the load side of the secondary SPD.

For the M30-ITS and 6-ITS cabinets install a 15A, industrial grade surge protected multiple outlet strip with no less than six outlets in the ITS compartment. Wire the outlet strip to one of the 15A circuit breakers in the ITS compartment. Attach the outlet strip to the bottom U-channel running horizontally across the back of the ITS compartment.

(iv) Additional Grounding. Install a #10 AWG bonding jumper from the

right-hand DIN rail mounting screw in the ITS compartment to the ground bar in the ITS compartment.

Install a #10 AWG bonding jumper from the top shelf in the signal cabinet to the ground bar in the signal cabinet.

(5) Prints, Functional Data, and Parts List. Ensure the manufacturer supplies each of the following items with each cabinet:

(a) Two complete set of schematic and wiring diagrams of the cabinet and terminal facilities.

(b) Cabinet mounting diagram.

(c) Complete parts list of cabinet and accessories.

Ensure each of these items applies directly to the cabinet with which it is applied. One set is to be put in the installed cabinet, and one set is to be furnished to the maintaining agency.

2. Accessories. This special provision defines the minimum acceptable requirementsfor plug-in accessories for the traffic controller assembly within a traffic control cabinet.

A. Malfunction Management Unit (MMU). This subsection defines the minimum requirements for a shelf-mountable, 16 channel, Ethernet capable MMU. Ensure the MMU meets, all applicable sections of the *NEMA Standard TS-2-2003 (R2008)* for MMU2 configuration while maintaining compatibility with *NEMA TS1-1989* assemblies. Where differences occur, this special provision governs.

Provide the following monitoring functions in addition to those required by the *NEMA standard*:

(1) Dual Indication Monitoring. Ensure the MMU can detect simultaneous input combinations of active green (or walk), yellow and red inputs on the same channel. Ensure the channels enabled for dual indication monitoring are user determined. Ensure dual indication monitor is disabled when the red enable input is not active.

(2) Field Check Monitoring. Ensure when the field signal inputs states sensed by the MMU do not correspond with the data provided by the CU in the type #0 message for 10 consecutive messages, the MMU enters the fault mode and indicates the field check fail fault.

(3) Recurrent Pulse Monitoring. Ensure the MMU detects conflict, red fail, and dual indication faults that result from intermittent or flickering field signal inputs.

(4) Ensure when the MMU detects a conflict flash indication it provides an output to the “D” connector indicating an MMU/conflict flash status input.

(5) Ensure the MMU monitors an intersection with up to four approaches using the four section Flashing Yellow Arrows (FYA) movement outlined by the *National Cooperative Highway Research Program (NCHRP) Research Project 3-54* on

Protected/Permissive signal displays with (FYA). Ensure the MMU provides the same fault coverage for the FYA approaches as it does for conventional movements including conflict, red fail, dual indications, and minimum clearance monitoring.

Ensure the MMU provides alternate configuration options as follows:

(a) Red Yellow Green (RYG) Only Red Fail Option. This function excludes the walk input from the red fail fault algorithm when operating the Type 12 mode.

(b) LED Signal Threshold Adjust. This function provides the capability to sense field inputs with an alternate set of voltage thresholds to better determine the state of LED signal indications. Conflict and dual indication thresholds for Green/Yellow/Red inputs are set for: No Detect is less than 15 root-mean-square voltage (Vrms). Detect is greater than 25Vrms. Red fail thresholds for Green/Yellow/Red are set for: No Detect is less than 50Vrms. Detect is greater than 70Vrms.

(c) Controller Voltage Monitor (CVM) Log Disable Option. Ensure the MMU provides a means to disable the logging of CVM faults events.

(d) Provide a 4 line by 20-character liquid-crystal display (LCD) to report MMU status, time and date, and menu navigation. Provide a separate Red, Yellow, Green LCD indicator, display for the input status of signal inputs. Provide individual icons to indicate channels involved in a fault.

(e) Provide a mode to display the Vrms of each field signal input and each cabinet control signal voltage, and the frequency of the AC line, the ambient temperature measured at the MMU.

(f) Ensure when the MMU is in the fault mode, a display screen is provided to identify all field signal inputs with field check status, and all field signal inputs with recurrent pulse status.

(g) Additional display functions include a configuration display of settings and all MMU configuration parameters; logs of previous fault, AC line, and MMU reset logs; clock set.

(h) Ensure the program card supplied with the MMU provides non-volatile memory that contains the configuration parameters for the enhanced features of the MMU, such that transferring the program card to a different MMU completely configures that MMU. Ensure the non-volatile memory device used on the program card does not utilize any input/output (I/O) pins designated as “Reserved” by *NEMA TS-2*.

(i) Ensure a minimum of five logs are provided that graphically display all field signal states and red enable for up to 30 seconds prior to the current fault trigger event. Ensure the resolution of the display is at least 50 milliseconds. Ensure these signal sequence logs are accessible from the front panel RJ-45 Ethernet port with software available from the manufacture.

B. Flasher. Provide a *NEMA* two-circuit, 15A per circuit, flasher for installation in the

cabinet. Ensure each flashing circuit contains zero-voltage switching, a 25A power triac, a snubber and a LED across the AC circuitry, directly indicating the AC load that is activated. Ensure the flasher conforms to a *Type 3 per Section 8* of the *NEMA Standards Publication*. Fabricate the flasher such that internal components are completely enclosed by the chassis.

C. Flash Transfer Relay. Provide flash transfer relays in the quantity of two each for the A2 configuration and six each for the A5 and A16 configurations for installation in the cabinet. Ensure the flash transfer relays conform to the following requirements:

(1) Mechanical Requirements. Enclose the relay in a transparent plastic case which protects the relay from dust, moisture, and other contamination. Ensure the case protects the user from contact with live parts and be sufficiently rugged to permit insertion and removal of the relay from its mating socket.

(2) Connector. Mount the relay on an eight-pin spade plus base and the socket and relay/base must be wired as follows:

Pin 1 - Coil	Pin 2 - Coil
Pin 3 - #1 Closed	Pin 4 - #2 Closed
Pin 5 - #1 Common	Pin 6 - #2 Common
Pin 7 - #1 Open	Pin 8 - #2 Open

(3) Contacts. Provide the relay with two single-pole, double-throw (form C) contact sets. Pin 8 - #2 Open each contact is rated to switch a 20A tungsten load for a minimum of 30,000 operations. The contact material must minimize welding.

(4) Coil Rating. Ensure the relay coil is rated for continuous duty from 95 to 135 volts alternating current (VAC). Ensure this rating is valid at 158 degrees F ambient temperature outside the relay case. Ensure the relay coil measures less than 10VA at 120VAC. Ensure the relay picks up by 95VAC and drops out by 50VAC, and makes the transfer within 50 milliseconds. Ensure the magnetic circuit in the relay reverses concurrently with the 60Hz AC input voltage.

D. Load Switches. Use solid-state load switching assemblies for opening and closing signal light circuits and be jack-mounted external to the CU. Ensure each load switch provides three independent switching circuits. Ensure each of the three circuits contains a zero-voltage switching optically coupled electrically isolating the DC input circuitry from the AC output circuitry, a 25A power triac and LED indicators on both the DC input circuitry and the AC output circuitry. Provide eight load switch assemblies (24 circuits) for the A2 configuration unit. Provide 12 load switch assemblies (36 circuits) for the A5 configuration unit. Provide 16 load switch assemblies (48 circuits) for the A16 configuration unit

3. Warranty. Provide materials with a manufacturer's warranty, transferable to the MDOT, that the supplied materials are free from all defects in materials and workmanship. Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, as shown on the plans and as directed by the Engineer.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Controller Cabinet, Modified	Each
Cabinet, Rem	Each

1. **Controller Cabinet, Modified** includes:

A. All labor, equipment, and materials required to install the traffic signal cabinet, and accessories required to provide the traffic signal control operation as shown on the plans and in accordance with the *MMUTCD* and this special provision.

B. Furnishing and delivering the cabinet to the maintaining agency for cabinet setup.

C. Transporting the cabinet from the maintaining agency to the job site for installation.

D. Salvaging all equipment not being replaced from the existing controller cabinet and re-installing within the new controller cabinet. All equipment including the existing cabinet being replaced shall remain in possession of the City of Kalamazoo. The Contractor will contact the City of Kalamazoo to notify them when the cabinet and equipment has been removed and is ready to be picked up.

2. **Cabinet, Rem** includes all labor, equipment, and materials required to remove an existing traffic signal cabinet.

The Engineer may process a partial payment for units delivered to MDOT signals shop or other approved location after initial inspection and acceptance and after the Contractor provides either a paid invoice/proof of payment or a receipt for delivery. If payment is based on the delivery invoice, the Contractor must provide a copy of the paid invoice/proof of payment to the supplier within 10 calendar days of the prime Contractor receiving payment for the materials. Partial payments for delivered materials/units meeting all project specifications will be limited to the smaller of the actual invoice amount or 96 percent of the contract bid amount. Final payment will be processed after final acceptance of the individual traffic signal installation.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

ETHERNET SWITCH with SFPs

a. Description. This work consists of furnishing and installing an environmentally hardened Managed Field Ethernet Switch (MFES) and all required power supplies, cables, patch cords and jumpers.

b. Materials. The MFES must be fully compatible and interoperable with MDOT's Intelligent Transportation Systems (ITS) network and the City of Kalamazoo and Road Commission of Kalamazoo County ITS network.

1. Furnish a MFES that is suitable for an ITS cabinet or NEMA Traffic Signal Control cabinet without the need for special environmental conditioning. The MFES must have no fan or other moving parts.

2. Ensure the MFES supports full-duplex Ethernet communication.

3. Provide a MFES that complies with the Institute of Electrical and Electronics Engineers (IEEE) networking standards IEEE-802.1 and IEEE-802.3. Specifically, the MFES must comply with the following IEEE-802.1 standards:

   A. IEEE 802.1ad – Q in Q / Provider Bridging Support or Stacked VLANS

   B. IEEE 802.1D Media Access Control (MAC) Bridges, including rapid spanning tree Protocol (RSTP)

   C. IEEE 802.1Q Virtual Local Area Network (VLAN) tagging and Multiple Spanning Tree Protocol (MSTP)

   D. IEEE 802.1X (Port Based Network Access Protocol)

   E. DHCP Snooping – ability to filter DHCP packets to ensure clients only use addresses assigned to them by authorized DHCP servers

   F. Dynamic ARP Inspection/Protection – ability to verify and filter ARP packets to prevent ARP spoofing

   G. (RFC 7039) IP Source Guard – ability to block IP source addresses that are not assigned to clients to prevent IP spoofing

   H. Port Security – ability to limit the MAC addresses that are allowed on a switch port

4. Provide a MFES that can be managed using Simple Network Management Protocol (SNMP) Version 3.

5. Provide a minimum of eight copper ports with Type Registered Jacks (RJ)-45 connectors, Seven of the ports must be capable of 10/100Base-TX communications with one port capable of 10/100/1000 Mbps. Furnish MFES with an adequate number of ports to accommodate Ethernet communications at each site as depicted on the plans, with the 10/100/1000 Mbps port set aside as a spare.

6. Provide a minimum of two Gigabit SFP Ports with 2 SFP 1 X 1000M Single Mode LC Connector type fiber transceivers. Provide fiber transceivers rated for a distance of 10km unless otherwise stated on the plans.

7. Electrical Specifications.

    A. Provide a power supply that interfaces the MFES to 120 volts alternating current (VAC), 60 hertz (Hz) single-phase power. If the device required operating voltages of less that 120 VAC, the appropriate voltage converter will be supplied at no additional cost.
    B. The MFES must consume no more than 20 watts (W) of power.
    C. Provide a MFES resistant to electromagnetic interference (EMI)

8. Environmental Specifications.

    A. MFES and its power supply must have an operating temperature range of at least -40 degrees F to 158 degrees F.
    B. MFES and its power supply must have an operating humidity range of at least 10 percent to 95 percent relative humidity (RH).

9. Provide a MFES with diagnostic light-emitting diodes (LED)s. These indicators must include link, activity, speed and power LEDs.

10. The MFES must use Secure File Transfer Protocol (SFTP) to transfer configuration files to and from a central server.

11. The MFES must perform multicast filtering using Internet Group Management Protocol (IGMP) snooping.

12. Provide power cables and Category 5e (CAT-5e) or Category 6 (CAT-6) patch cords as required.

13. Provide a MFES that has American Standard Code for Information Interchange (ASCII) based configuration files for offline editing and bulk configuration.

14. Provide all mounting hardware needed to mount the MFES and power supply. If the MFES is mounted on a shelf, provide a grid-type shelf the minimizes the interference with air flow.

15. The MFES must be configurable using a web browser or Graphical User Interface (GUI), in addition to the terminal emulation.

16. The MFES must be able to backup and restore the complete software configuration, in the field by, without the use of a PC, powered by the console port, and only use a one (1) button handheld data backup unit (DBU), capable of being used by a technician with no network programming knowledge.

17. Unless stated specifically on the plans, the Contractor shall furnish the traffic signal TS1/TS2 NEMA detector card rack style fiber and copper Ethernet switch.

c. Construction.

1. Connect the MFES to the communications network and ensure connections are made to each Ethernet/Internet Protocol (IP) appliance within the cabinet. Use CAT-5e or CAT-6 patch cords for twisted pair connections to the MFES.

2. Install using setting that were approved at equipment mock up or as approved by the Engineer and Owner to ensure interoperability and security.

3. Provision MFES with IP address and network setting provided by the Engineer or Owner.

4. Mount the MFES in the cabinet using the rack. Install MFES in a way to allow the MFES to by fully accessible by field technicians.

5. Warranty. Provide a manufacturer warranty (parts, software and labor) of five (5) years from the date of final acceptance.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Ethernet Switch with SFPs	Each

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

TWO-WAY ILLUMINATED STREET NAME SIGNS (LED)

PAE/DWW 12/04/2023

a. Description. This work consists of installing a LED illuminated street name sign, which includes the associated assembly, brackets, hardware, fittings, cable, connectors, wiring, grounding, and all other material required to complete the work.

b. Materials. Material must meet sections 918 and 921 of the Standard Specifications for Construction and this special provision.

1. General Requirements. The sign assembly must consist of a 6 or 8 foot aluminum body with white LEDs. The sign assembly must consist of two faces, as specified. Overall sign dimensions must be 72⅜ inches long by $22^{5}/_{16}$ inches high for the 6 foot sign and 96⅜ inches long by $22^{5}/_{16}$ inches high for the 8 foot sign. Signs must be 10¾inches deep at the top (including the drip edge) and 5⅞ inches deep at the bottom. The 6 foot sign must weigh no more than 75 pounds and the 8 foot sign must weight no more than 90 pounds. When mounted, the sign must provide a five degree downward angle for increased visibility.

The body of the sign must consist of an aluminum housing. Extrude the top from 6063-T5 aluminum alloy with a minimum thickness of 0.140 inches. Ensure there are drip rails overhanging the sign face to prevent water from entering the electrical housing.

Extrude the bottom of the sign from 6063-T5 aluminum alloy with a minimum thickness of 0.09 inches. Cast the ends of the sign from 356 aluminum having a minimum thickness of 0.250 inches.

Continuously weld all seams for a weather tight seal. Locate four drain holes in the bottom of the body, two at each end of the sign.

Etch and prime the exterior of the sign in accordance with industry standards before receiving two color coats of industrial enamel. Ensure all fasteners and hardware are corrosion resistant.

Ensure the legend of the sign is as indicated on the plans.

Ensure the size of the sign is as indicated on the plans.

2. Door Requirements. The aluminum doors must have one side removable for access to the sign face. Each door must have a full length 0.040 inch by 1⅛ inch open stainless steel hinge on the bottom edge. Secure the door from opening by six quarter turn air lock fasteners. Install PVC foam gaskets or a neoprene gasket, 5/32 inch thick by 1 inch wide, to provide a watertight seal between the door and housing.

3. Sign Face Requirements. Construct the sign face of 0.125 inch thick Lexan (a transparent plastic (polycarbonate) of high impact strength) SG404-7329 white translucent polycarbonate. Ensure letter style is Clearview Highway 2W font with 12 inch upper case and proportional lower case letters. Ensure the sign face legend background is translucent with vinyl blue electrically cuttable film applied to the front of the sign face. Frame the legend by a white polycarbonate border.

4. Electrical. Design the LED case sign to operate on 120 Volt, 60 Hertz, single phase alternating current (AC) power. Ensure the input voltage is reduced and power-conditioning circuitry is provided so that the LED's current will operate at the manufacturer's recommended current.

The LED light module must consist of adequate LED's to provide a minimum of 200 nits or an equivalence of 660 lux over a -40 ºF to 165 ºF ambient temperature consistent with the *NEMA* temperature specifications. Ensure there are a sufficient quantity of white LEDs to uniformly illuminate the viewing area.

The LED light module must consist of a circuit board comprised of an insulate aluminum substrate, with a minimum thickness of 0.050 inch.

The LED light module must operate for a minimum of 50,000 hour life with no more than 30 percent lumen depreciation. The LED supplier must provide operational documentation, if requested, based on actual temperature measurements (taken after 12 continuous hours of operation) correlated against lumen depreciation and LED mortality curves.

Ensure the LED light engine electronics are entirely coated not thinner than 0.002 inch (dry), to adequately protect the light engine from moisture and corrosion. Ensure the LED module is Reduction of Hazardous Substances (ROHS) compliant.

Provide a sufficient quantity of white LED's to uniformly illuminate the view area. The failure of one LED must not reduce the light output by more than eight percent per foot of sign face.

Ensure circuit conductors and LED attachment adhesive is minimally 90 percent silver to ensure optimal electrical and thermal conductivity.

Attach the LED light module to the case sign housing in such a manner that it will remain properly in place during maintenance or retro-fit activities. The LED light module must pass the following tests per *NEMA* standards:

A. Thermal Shock Test. 85/-40 ºF with 2 hour dwells for five cycles with a 2 hour presoak at -40 ºF.

B. Salt Spray and Soak Test. The LED light module must endure 48 hours on continuous salt spray and 240 hours of salt-water soak.

Burn-in all LED light modules for 24 hours and certified for compliance by the manufacturer. Ensure the manufacturer's name, date of manufacture, and a QC tracking sticker are mounted on the inside of the LED light module.

The LED light modules must not exceed a 59 ºF (15 ºC) temperature rise under continuous operating conditions.

Provide power supplies rated for 100 watts by UL for Class 2 operation (24 VDC) and IP66 rated for outdoor use. Ensure two power supply are used for two-way signs. Ensure the temperature rise of the LED panel does not exceed 59 ºF (15 ºC) under continuous operating conditions at the rated output.

5. Mounting Brackets. Mount the signs as specified on the plans.

6. Warranty. Provide materials with a manufacturer's warranty/guarantee, transferable to MDOT, that the supplied materials will be free from all defects in materials and workmanship for the stated time period from the date of shipment. Supply the Engineer with warranty/guarantee documents from the manufacturer and a copy of the invoice showing the date of shipment.

c. Construction. Furnish and install, an LED street name sign, as indicated on the plans or as directed by the Engineer. Ensure work complies with sections 819 and 820 of the Standard Specifications for Construction and this special provision.

Design the wiring for 600 volts at 90 ºF using a minimum #18 AWG stranded soft annealed copper wire. Secure all wiring using insulated wire compression nuts. Furnish a wire entrance junction box with the sign assembly which provides a weather-tight seal. No wiring is allowed within the optical cavity.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Street Name Sign, Two Way, LED Illuminated 6 foot	Each
Street Name Sign, Two Way, LED Illuminated 8 foot	Each

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

UNIVERSAL CAMERA BRACKET AND EXTENSION

Wightman/PAD 10/09/2022

Description

These specifications are for mounting assemblies used to install vehicle video detection cameras above traffic signal mast arms. A mounting assembly shall include all hardware for a complete assembly to allow for pan/tilt function of the camera above the mast arm.

Materials

1. Mast Arm Mounting Assembly

A. The mast arm mounting assembly shall consist of a camera pan/tilt bracket, vertical support tube and mast arm clamp assembly. The bracket shall be completely adjustable so that it provides all vertical and horizontal alignment of the camera assembly.

B. Both halves of the mast arm clamp assembly shall be cast from 356-T6 aluminum alloy or equivalent. The halves shall be secured to each other with a spring steel retainer ring. The assembly shall provide an unobstructed center of 2-3/8 inches minimum diameter, allowing for 360-degree rotation of the clamp assembly. There shall be no internal cross bracing assembly obstructing the center opening. The clamp assembly shall be equipped with two (2) stainless steel bands, 5/8 inches wide, 0.045 inches thick and a minimum 36 inches long with a minimum tensile strength of 100,000 PSI. A setscrew secured buckle shall be utilized in securing the band. An optional 3/16-inch stainless steel aircraft type stranded cable may be provided. The cable shall be complete with 7/16-inch stainless steel clamp screw permanently attached to each end of the cable. The cable shall be a minimum of 7 feet in length.

2. Vertical Support – The vertical support tube shall be a double gusseted tube extruded from 6063-T6 aluminum alloy. Each tube shall be complete with a vinyl closure strap and be threaded on one end to accommodate the lower arm assembly. Tube length shall be 10 feet.

3. Camera Mounting Bracket – The camera-mounting bracket shall consist of one-piece aluminum bracket with 3/8” stainless steel mounting hardware allowing direct mounting to the camera flange assembly. This welded bracket shall have 1 1/2” NPS threaded pipe coupling to mount to the threaded support tube (2) 1/4" stainless steel set screw shall be included with the coupling.

4. Packing and Marking – Each bracket shall be individually wrapped in a plastic bag to prevent damage during shipment. Each carton shall be legibly marked with the Mounting Assembly description, purchase order number, and vendor’s name.

Construction

None specified.

Measurement and Payment

This work will be paid for at the contract unit price for each bracket and extension that is installed using the following pay item:

Pay Item	*Pay Unit*
Universal Camera Bracket and Extension	Each

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

VIDEO DETECTION SYSTEM
VIDEO DETECTION CAMERA

a. Description. This specification sets forth the minimum requirements for a Video Detection System (VDS) and Video Detection Camera (VDC) that detects vehicles on a roadway using only video images of vehicle and bicycle traffic.

The video detection system (VDS) shall support up to four video cameras, and four video detection processors (VDP) capable of processing one video source each, one Central Control Unit (CCU), input/output extension modules, video surge suppressors and a pointing device, or any combination thereof.

The VDS will be deployed at locations where site conditions and roadway geometry vary. The VDS system may also be deployed at locations where existing cabinets or equipment exist. Existing site configurations will dictate the availability of cabinet space and VDS usage.

The system shall include software that discriminately detects the presence of individual vehicles and bicycles in a single or multiple lanes using only the video image. Detection zones shall be defined using only an embedded software application. A monitor, a keyboard and a pointing device are used to place the zones on a video image. A minimum of 32 detection zones per camera view shall be available. A separate computer shall not be required to program the detection zones.

b. Materials. Provide materials in accordance with the following requirements of this special provision.

1. VDS Hardware Video Detection Processor System Interfaces. The following interfaces shall be provided on each video detection processor:

   A. Video Input - Each VDP will be supplied with video from the VDS Camera Sensor. The interface connector shall be an RJ-45 type and shall be located on the back of the CCU unit.

   B. Video Lock LED - A LED indicator shall be provided to indicate the presence of the video signal. The LED shall illuminate upon valid video synchronization and turn off when the presence of a valid video signal is removed.

   C. Contact Closure Output - Open collector (contact closure) outputs shall be provided. Four (4) open collector outputs shall be provided for the Video Detection Processor rack-mount configuration. Additionally, the VDS shall allow the use of extension modules to provide up to 32 open collector contact closures per camera input. Each open collector output shall be capable of

sinking 30mA at 24VDC. Open collector outputs will be used for vehicle detection indicators as well as discrete outputs for alarm conditions. The VDP outputs shall be compatible with industry standard detector racks assignments.

D. Logic Inputs - Logic inputs such as delay/extend or delay inhibit shall be supported through the appropriate detector rack connector pin or front panel connector in the case of the I/O module. For VDPs and extension modules, 4 inputs shall be supported via detector rack interface. The I/O module shall accommodate eight (8) inputs through a 15-pin “D” connector.

E. Detection LEDs - Detection status LEDs shall be provided on the front panel. The LEDs shall illuminate when a contact closure output occurs. Rack-mounted video processors shall have a minimum of four (4) LEDs. Rack-mounted extension modules shall have two (2), four (4) or eight (8) LEDs (depending upon extension module type) to indicate detection.

F. Test Switches - The front panel of the VDP shall have detector test switches to allow the user to manually place vehicle and bicycle calls on each VDP output channel. The test switch shall be able to place a momentary call.

G. Both the VDP and EM shall be specifically designed to mount in a standard detector rack, using the edge connector to obtain power, provide contact closure outputs and accept logic inputs (e.g. delay/extend). No adapters shall be required to mount the VDP or EM in a standard detector rack and no rack rewiring shall not be required.

H. VDP printed circuit boards (PCBs) shall be conformally coated in accordance with Caltrans and NEMA specifications.

I. On-board Memory - The VDP shall utilize non-volatile memory technology to store on- board firmware and operational data.

J. Firmware Upgrade - The VDP and CCU shall enable the loading of modified or enhanced software through either the Ethernet or front-panel USB port (using a USB thumb drive) and without removing or modifying the VDP or CCU hardware.

K. VDP and EM Power - The VDP and EM shall be powered by 12 or 24 volts DC. VDP and EM modules shall automatically compensate for either 12 or 24 VDC operation. VDP power consumption shall not exceed 7.5 watts. The EM power consumption shall not exceed 3 watts.

L. Operating Temperature - The VDS shall operate satisfactorily in a temperature range from -30° F to +165° F (-34° C to +74° C) and a humidity range from 0%RH to 95%RH, non- condensing as set forth in NEMA specifications.

2. VDS CCU. The VDS CCU sensor shall be supplied by the VDS manufacturer.

A. Hardware - The CCU shall be supplied in a standard One (1) Rack Unit (1U) 19" rack format. There shall be brackets to allow the CCU to be mounted under shelves where a 19" frame is not available.

B. CCU Power - The CCU shall be powered from an 110V or 230V, 50Hz or 60Hz supply. CCU power consumption shall not exceed 20 Watts.

C. Operating Temperature - The VDS shall operate satisfactorily in a temperature range from -30° F to +165° F (-34° C to +74° C) and a humidity range from 0%RH to 95%RH, non- condensing as set forth in NEMA specifications.

D. On-board Memory - The CCU shall utilize non-volatile memory technology to store on- board firmware and operational data.

E. Video Surge Suppression - The CCU shall incorporate video surge suppression for each video input. The CCU shall be appropriately grounded to the cabinet ground rod using 14 AWG ($2.5mm^2$) minimum.

F. Power Surge Suppression - The CCU shall incorporate power surge suppression both on the input power and on the power supplied to the cameras. The CCU shall be appropriately grounded to the cabinet ground rod using 14 AWG ($2.5mm^2$) minimum.

G. Power Management - The CCU shall incorporate power management for the various parts of the VDS such that if fault conditions are detected the power supply will safely shut down the power to that peripheral.

H. Interfaces

(1) Extension Modules (EM) shall be available to eliminate the need of rewiring the detector rack, by enabling the user to plug an extension module into the appropriate slot in the detector rack to provide additional open collector outputs. The EM shall be available in both 2- and 4-channel configurations. EM configurations shall be programmable from the CCU. A separate I/O module shall also be available having 32 outputs through a 37-pin "D" connector on the front panel and 8 inputs through a 15-pin "D" connector using an external wire harness for expanded flexibility.

(2) The CCU shall provide four ports for connection to VDS camera sensors. The connector shall be an RJ-45 type.

(3) The CCU shall provide four ports for connection to VDPs. The connector shall be an RJ-45 type.

(4) The CCU shall provide 2 USB 'A' ports on the front panel of the rack mount CCU unit. These ports can be utilized for various functions. For example, keyboard and mouse functions during system configuration, USB storage devices can be utilized for bin data and video collection. The USB ports shall not require special mouse software drivers. The USB ports shall be used as part of system setup and configuration.

(5) The CCU shall provide an output to a monitor. The port shall be HDMI.

(6) Communications - An Ethernet communications port shall be provided on the front panel. The Ethernet port shall be compliant with IEEE 802.3 and shall use a RJ-45 type connector mounted on the front panel of the CCU. The Ethernet communications interface shall allow the user to remotely configure the system and/or to extract calculated vehicle/roadway information. The interface protocol shall be documented or interface software shall be provided. Each VDS shall have the capability to be addressable. The VDP shall support data rates of up to100Mbps.

(7) The CCU shall provide an SDLC connection to the Traffic Controller. The connector shall be a 'D-15' type, in compliance with NEMA TS-2 specifications.

(8) The CCU shall provide an indicator when the SDLC port is active.

(9) The CCU shall provide an indicator when the unit has power.

(10) The CCU shall provide an indicator when the unit is on line.

(11) The CCU shall provide a Wi-Fi connection. The connection shall be over a standard 2.4GHz connection. The Wi-Fi connection shall be enabled and disabled by a switch on the CCU. The CCU shall provide an indicator when the Wi-Fi connection is active.

(12) The CCU shall provide system status via an on-board Organic Light Emitting Diode display. The display shall indicate various system parameters, such as camera health and VDP health, firmware version and camera air temperature. The display with be enabled and disabled with a switch on the CCU.

3. VDS Camera Sensor. The VDS camera sensor shall be supplied by the VDS manufacturer.

A. The VDS shall be of the *Vantage Next* type as manufactured by Iteris or equal approved by the Owner and Engineer.

B. The VDS camera sensor shall utilize a single shielded CAT5E or CAT6

cable for power and video. Cable termination at the camera shall not require crimping or special tools. The cable termination shall only require a standard wire stripper and a screw driver. No connectors (e.g. BNC) shall be allowed.

C. The camera sensor shall allow the user to set the focus and field of view via the VDS software. Camera sensor control from the controller cabinet shall communicate over a single Cat- 5e or CAT6 cable. No additional wires shall be required.

D. The camera shall produce a useable video image of the features of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 0.003 lux to 10,000 lux.

E. The camera electronics shall include automatic gain control (AGC) to produce a satisfactory image at night for the VDS algorithms.

F. The imager luminance signal to noise ratio (S/N) shall be more than 50 dB with the automatic gain control (AGC) disabled.

G. The imager shall employ three dimensional dynamic noise reduction (3D-DNR) to remove unwanted image noise.

H. The camera imager shall employ wide dynamic range (WDR) technology to compensate for wide dynamic outdoor lighting conditions. The dynamic range shall be greater than 100 dB.

I. The camera shall be digital signal processor (DSP) based and shall use a CCD sensing element and shall output color video with resolution of not less than 540 TV lines. The color CCD imager shall have a minimum effective area of 811(h) x 508(v) pixels.

J. The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter. The electronic shutter shall operate between the range of 1/60th to 1/90,000th second.

K. The camera shall utilize automatic white balance.

L. The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening up the camera housing, to suit the site geometry by means of a portable interface device designed for that purpose and manufactured by the detection system supplier.

M. The horizontal field of view shall be adjustable from 4.5 to 48 degrees. This camera configuration may be used for the majority of detection approaches in order to minimize the setup time and spares required by the

user. The lens shall be a 12x zoom lens with a focal length of 3.5mm to 35mm.

N. The lens shall also have an auto-focus feature with a manual override to facilitate ease of setup.

O. The camera shall incorporate the use of preset positioning that store zoom and focus positioning information. The camera shall have the capability to recall the previously stored preset upon application of power.

P. The camera shall be housed in a weather-tight sealed enclosure. The housing shall allow the camera to be rotated to allow proper alignment between the camera and the traveled road surface.

Q. The camera enclosure shall be equipped with a sunshield. The sunshield shall include a provision for water diversion to prevent water from flowing in the camera's field of view. The camera enclosure with sunshield shall be less than 3.5" (89mm) diameter, less than 5.25" (133mm) long, and shall weigh less than 2.5 pounds (1.14kg) when the camera and lens are mounted inside the enclosure.

R. The enclosure shall be designed so that the pan, tilt and rotation of the camera assembly can be accomplished independently without affecting the other settings.

S. The camera enclosure shall include a proportionally controlled Indium Tin Oxide (ITO) lens coating for the heating element of the front glass that maximizes heat transfer to the lens. The output power of the heater shall vary with temperature, to assure proper operation of the lens functions at low temperatures and prevent moisture condensation on the optical faceplate of the enclosure. The transparent coating shall not impact the visual acuity and shall be optically clear.

T. The glass face on the front of the enclosure shall have an anti-reflective coating to minimize light and image reflections.

U. When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -30° F to +140° F (-34 °C to +60 °C) and a humidity range from 0% RH to 100% RH. Measurement of satisfactory video shall be based upon VDP system operation.

V. The camera shall be powered by 48VDC. Power consumption shall be 5 watts typical and 16 watts or less under worst conditions.

W. Recommended camera placement height shall be 33 feet (or 10 meters) above the roadway, and over the traveled way on which vehicles are to be detected. For optimum detection the camera should be centered above the traveled roadway. The camera shall view approaching vehicles at a distance

not to exceed 350 feet (107 meters) for reliable detection (height to distance ratio of 10:100). Camera placement and field of view (FOV) shall be unobstructed and as noted in the installation documentation provided by the supplier.

X. The video signal shall be fully isolated from the camera enclosure.

Y. Cable terminations at the camera for video and power shall not require crimping tools.

Z. A weather-proof protective cover shall be provided shall be provided to protect all terminations at the camera. No special tooling shall be required to remove or install the protective cap.

AA. The camera assembly shall include a temperature sensor. The sensor will be polled by the VDS every minute and will supply the current air temperature. The VDS software will display this information on the On-Screen Display for each camera.

4. VDS Software.

A. General System Functions

(1) Detection zones shall be programmed via an embedded application displayed on a video monitor and a keyboard and a pointing device connected to the CCU. The menu shall facilitate placement of detection zones and setting of zone parameters or to configure system parameters. A separate computer shall not be required for programming detection zones or to view system operation. All programming function shall occur on live video images, no snapshots or still images are allowed.

(2) The VDS software shall store up to five completely independent detection zone patterns in non-volatile memory. The VDS can switch to any one of the three different detection patterns within 1 second of user request via menu selection with the pointing device. Each configuration shall be uniquely labeled and able to be edited by the user for identification. The currently active configuration indicator shall be displayed on the monitor.

(3) The VDS shall detect vehicles and bicycles in real time as they travel across each detection zone.

(4) The VDS shall accept new detection patterns from an external computer through the Ethernet port when the external computer uses the correct communications protocol for downloading detection patterns. A Windows™-based software designed for local or remote connection and providing video capture, real-time detection indication and detection zone modification capability shall be provided with the system.

The VDS shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.

(5) The VDS shall send its detection patterns to an external computer through the Ethernet port when requested when the external computer uses the appropriate communications protocol for uploading detection patterns.

(6) The VDS shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference or loss of the video signal.

(7) The VDS shall be capable of automatically detecting a low-visibility condition such as fog and respond by placing all affected detection zones in a constant call mode. A user-selected alarm output shall be active during the low-visibility condition that can be used to modify the controller operation if connected to the appropriate controller input modifier(s). The system shall automatically revert to normal detection mode when the low-visibility condition no longer exists. An On-Screen Icon will be displayed while the system is in this mode.

(8) Up to 32 detection zones per camera input shall be supported and each detection zone must be user-sizeable to suit the site and the desired vehicle detection region.

(9) The VDS shall provide up to 32 open collector output channels per camera input using one or more extension modules.

(10) A single detection zone shall be able to replace multiple inductive loops and the detection zones shall be OR'ed as the default or may instead be AND'ed together to indicate vehicle presence on a single approach of traffic movement.

(11) When a vehicle is detected within a detection zone, a visual indication of the detection shall activate on the video overlay display to confirm the detection of the vehicle for the zone.

(12) Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, camera placement, camera quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to camera location or quality.

(13) The VDS shall provide dynamic zone reconfiguration (DZR). DZR sustains normal operation of existing detection zones when one zone is

being added or modified during the setup process. The new zone configuration shall not go into effect until the configuration is saved by the operator.

(14) Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.

(15) The VDS shall process the video input from each camera at 30 frames per second. Multiple camera processors shall process all video inputs simultaneously.

(16) The VDS shall output a constant call during the background learning period of no longer than 3 minutes.

(17) Detection zone outputs shall be individually configurable to allow the selection of presence, pulse, extend, and delay outputs. Timing parameters of pulse, extend, and delay outputs shall be user definable between 0.1 to 25.0 seconds.

(18) Up to six detection zones per camera view shall have the capability to count the number of vehicles detected. The count value shall be internally stored for later retrieval through the Ethernet port. The zone shall also have the capability to calculate and store average speed and lane occupancy at user-selectable bin intervals of 10 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes and 60 minutes.

(19) In addition to the count type zone, the VDS shall be able to calculate average speed and lane occupancy for all of the zones independently. These values shall be stored in non-volatile memory for later retrieval.

(20) The VDS shall have an “advance” zone type where raw detection output duration to the traffic controller is compensated for angular occlusion and distance.

(21) The VDS shall employ color overlays on the video output.

(22) The VDS shall have the ability to show controller phase status (green, yellow, or red) for up to 8 phases. These indications shall also be color coded.

(23) The user shall have the ability to enable or disable the display of the phase information on the video output.

(24) The VDS shall have the capability to change the characteristics of a detection zone based on external inputs such as signal phase. Each detection zone shall be able to switch from one zone type (i.e. presence, extension, pulse, etc.) to another zone type based on the signal state. For example, a zone may be a “count” zone when the phase is green

but change to a “presence” zone type when the phase is not green. Another application would be zone type of “extension” when the signal phase is green and then “delay” when red.

(25) The VDS software shall aid the user in drawing additional detection zones by automatically drawing and placing zones at appropriate locations with only a single click of the mouse. The additional zone shall utilize geometric extrapolation of the parent zone when creating the child zone. The process shall also automatically accommodate lane marking angles and zone overlaps.

(26) When the user wishes to modify the location of a zone, the VDS software shall allow the user move a single zone, multiple zones or all zones simultaneously.

(27) When the user wishes to modify the geometric shape of the zone, the VDS software shall allow the user to change the shape by moving the zone corner or zone sides.

(28) On screen zone identifiers shall be modifiable by the user. The user shall be allowed to select channel output assignments, zone type, input status, zone labels or zone numbers to be the identifier.

(29) The VDS software shall support bicycle type zones where the zone can differentiate between motorized vehicles and bicycles, producing a call for one but not the other.

(30) Bicycle zone types shall only output when a bicycle is detected. Larger motorized vehicles such as cars and trucks that traverse a bicycle zone shall not provide an output.

(31) The VDS software shall provide the ability to assign a separate output channel for bicycle zones to allow traffic controllers to implement special bicycle timing.

(32) Placement of bicycle type zones in vehicle lanes shall be allowed.

(33) Upon detection of a bicycle, the video output overlay shall indicate active detection as well as providing a unique bicycle detection identifier to visually distinguish bicycle detection versus vehicle detection.

(34) Up to six bicycle detection zones per camera view shall have the capability to count the number of bicycles detected in addition to their normal detection function. The count value shall be internally stored for later retrieval through the Ethernet port.

(35) Automatic Traffic Volume Graph - The On-Screen Display shall include an Automatic Traffic Volume graph. This graph will display

estimated Vehicles Per Hour (VPH) per movement for each camera view. The graph will display a rolling 24 hour period of VPH.

(36) Occupancy Graph - The On-Screen Display shall include an Occupancy Graph. This graph will display estimated approach occupancy for each camera view. The graph will display a rolling 24 hour period of Occupancy.

B. User Interfaces - This section sets forth the minimum requirements for the VDS to provide a single point interface to remote and local users. The VDS shall also have the capability to stream up to four simultaneous video streams over an Ethernet interface.

(1) The user interface shall provide capabilities to enable multiple rack-mounted video detection processors to be locally and remotely accessed from a single point via an Ethernet connection.

(2) The device shall allow the operator to view four videos simultaneously or any one video by controls embedded in the VDS.

(3) Local user access to video detection programming shall be limited to the detection processor unit that is currently being displayed on the monitor.

(4) All local programming and setup parameters for the video detection processor shall be user accessible through the interface unit without requiring the user to swap user interface cables between video detection processors.

(5) Remote access to the device shall be through the built-in Ethernet port via access software running on a Microsoft Windows based personal computer.

(6) A Windows OS remote access firmware shall also be available for remote setup and diagnostics of the interface unit.

(7) The VDS shall support streaming video technology using H.264 standards to allow the user to monitor video detection imagery over the Ethernet interface. Motion JPEG streaming video shall not be allowed.

(8) The interface unit shall allow eight independent streams, one from each video processor, to be transported via Ethernet to four independent streaming video players simultaneously in D1 resolution.

(9) The interface shall allow the user to select the resolution of the displayed streamed video.

(10) The interface unit shall support the streaming and display of eight

concurrent streams in D1 resolution.

(11) The VDS shall allow the user to manage the unit's Ethernet bandwidth usage by allowing the user to select high, medium or low resolution.

(12) The interface shall allow the user to change the unit's Ethernet network settings of IP address, subnet mask and default gateway.

(13) The VDS shall allow the user to upload new application firmware through the use of the interface, remotely or on-site.

(14) A Windows OS based application will be provided to remotely view video streams from the VDS.

(15) An iOS based application will be provided to remotely view video streams from the VDS. This application shall allow the user to choose between any number of pre- configured intersection locations. The live video from any cameras at that location will be viewable on an iOS product, including the vehicle and bicycle detections occurring in real-time.

c. SDLC Functionality. This section sets forth the minimum requirements for a full-function BIU and integrated video detection communication. The VDS shall provide outputs to the controller of vehicle calls from video processors that reside within the detector rack**.**

1. Functional Capabilities - The VDS shall have the capability of monitoring phase information and passing that information and other system data such as "time" from the controller to video detection processor modules. The VDP shall also accept data from video processor modules and relay the information to the controller. The unit shall provide a maximum of 64 detector outputs to the controller via the SDLC interface.

2. Requirements - The module shall be in compliance with the following industry specifications:

   A. Transportation *Electrical Equipment Specifications (TEES)*, August 16, 2002 (or latest edition)*,* California Department of Transportation

   B. *NEMA* Standard *Publication TS 1-1989* (or latest edition)*, Traffic Control Systems,* National Electrical Manufacturers Association

   C. *NEMA* Standard *Publication TS 2-2003, Traffic Controller Assemblies With NTCIP Requirements, Version 02.06* (or latest edition)*,* National Electrical Manufacturers Association

3. Data Interfaces - The VDS shall have two data interfaces:

The interface to the controller shall be accomplished by the use of the TS-2 SDLC port and protocol in accordance with the TS-2 specifications. The module shall be able to be configured to respond to BIU addresses 8, 9, 10 and 11 or a combination thereof.

The interface to communicate with card rack video detection processors shall be manufacturer specific.

4. SDLC Communication Indicators - One LED indicator shall be provided for the TS-2 SDLC interface. The indicator shall be used to inform the user of any communication activity on the SDLC port.

d. Warranty.

1. The supplier shall provide a limited three-year warranty on the video detection system.

2. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers.

3. During the warranty period, updates to VDP software shall be available from the supplier without charge.

4. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the video detection system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.

5. The supplier shall maintain an ongoing program of technical support for the video detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on site technical support services.

6. Installation or training support shall be provided by a factory-authorized representative and shall be a minimum IMSA-Level II Traffic Signal Technician certified.

7. All product documentation shall be written in the English language.

e. Construction. The cable to be used between the camera and the CCU in the traffic cabinet shall be Cat-5e, shielded, direct burial. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. Shielded RJ-45 connectors shall be used where applicable. The Cat-5e cable, RJ- 45 connector, stripping and crimping tool shall be approved by the supplier of the video detection system, and the manufacturer's instructions must be followed to ensure proper connection.

The video detection camera shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided.

f. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Video Detection System	Each
Video Detection Camera	Each

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

TRAFFIC SIGNAL POWER BACKUP SYSTEM

a. Description. This work consists of installing or removing an on-line, power conditioner and uninterruptible power system (UPS) with battery backup capability (with cabinet) designed for transportation and traffic applications including mounting brackets, hardware, fittings, cable, connectors, grounding, and other material necessary to complete the work. Provide a UPS that is dual microprocessor controlled with a software driven power system, and is compatible for installation within a traffic signal controller cabinet environment. Provide a UPS that includes an inverter which operates as needed supplying clean regulated power (both voltage and frequency) to all loads, have full power factor correction, and be completely compatible with any type of auxiliary power generator, or a line-interactive UPS.

b. Materials. Provide material meeting sections 918 and 921 of the Standard Specifications for Construction and the requirements of this special provision.

1. Operation.

A. Provide a UPS that is capable of simultaneously producing a fully regenerated and regulated true sine-wave conditioned power output with a continuous and hot standby alternating current (AC) output or a line-interactive true UPS, that will provide a continuously regulated voltage to the load in line when on inverter mode.

B. Provide a UPS inverter, as required to produce continuous, clean, regulated power to all loads that has a minimum operating efficiency of 92 percent or a line-interactive UPS that is 98 percent efficient in line mode and 83 percent efficient in inverter mode. Provide a continuous power output for signals, controllers and modems, etc.; and provide a standby output for signals, if so required. Provide a UPS capable of supplying power, up to the maximum load rating, to any combination of signal heads, whether incandescent, light emitting diode (LED), or neon, by any manufacturer, regardless of power factor, without overdriving the LED heads which may cause early degradation, low luminosity, or early signal failure. Provide a programmable digital delay timer for short-term battery use under full cycling operation.

C. Provide a UPS that is capable of utilizing battery power in support of the system upon the loss of utility supplied power. In normal operation, ensure the UPS operates in the real-time true on-line mode with the inverter supplying power to all cabinet loads, at all times. Provide a UPS that operates in hot standby mode with power transfer being accomplished in 100 milliseconds or less, if required. In the event of UPS failure and/or battery depletion, ensure the UPS drops out, and upon the return of utility power the traffic control system, defaults to a normal operating mode.

D. Provide a by-pass switch that enables removal and replacement of the UPS

without shutting down the traffic control system (i.e., “hot swap” capability). Ensure connectors are equipped with a “safety interlock” feature or finger-safe terminal blocks.

E. Provide a UPS that includes an LED display on the front panel that is used to show various real time operational parameters of the UPS. Ensure the LED display operates in the two following modes; Normal Mode is the default mode for displaying real time UPS parameters, and Menu Mode is for accessing additional system information and for programming any modifiable UPS parameters. Ensure the programmable liquid crystal display (LCD) is capable of providing the following information; Battery System Status; Power System; UPS System; UPS Information; Event Log; Time/Date; and Relay Status.

F. Utilize existing Flasher Modules and Flash Transfer Relays (FTRs).

G. Provide a UPS that is fully compatible with police panel functions (i.e., “signals OFF” switch must kill the power to any field wiring even when on UPS/Battery power), to facilitate emergency crews and police activities.

H. Provide a UPS that does not duplicate or take over flash operation or flash transfer relay functions, and is capable of providing continuous, fully conditioned, or regulated pure sinusoidal AC power to all connected devices such as signal controllers, modems, communications hubs, *National Transportation Communications for Intelligent Transportation Systems (ITS) Protocol (NTCIP)* adapters and video equipment at all times.

I. Ensure the UPS is *NTCIP* capable, with optional standard adapter, and contains two external serial ports, or one serial port, and five dry contact terminal blocks located on the front panel of the UPS. Ensure the Signal serial port provides the user the option to select alarm output functions. Ensure these functions are open collector type contact closures or dry contacts the user can assign as signal utility interrupt, low battery and inverter active conditions, or utility failure indicator. Ensure these signals are capable of being interfaced to any manufacturer’s controller auxiliary alarm inputs or the Power Interface Module (PIM). Ensure the recommended standard (RS)-232 Signal port and Universal Serial Bus (USB) provides an intelligent interface for connection to optional software systems for monitoring and control, including internet connections.

J. Provide a UPS that has full power factor correction under all operating conditions.

2. Components. Provide a UPS that consists of three major components, the UPS module, a by-pass switch, and the battery system.

A. Provide a UPS module that consists of the following:

(1) True on-line, double conversion, pure sine-wave, high frequency inverter utilizing insulated gate bipolar transistor (IGBT) technology or a line-interactive true UPS utilizing field-effect transistors (FET).

(2) Three-stage, temperature compensated, battery charger.

(3) Digital microprocessor-based timer for programmable flash command requirements.

(4) Provide dedicated harnesses with quick-release, keyed, circular connectors,

and braided nylon sleeve over all conductors for connection from the UPS module to the by-pass switch and battery system or hard-wired AC interconnect cables and battery cable kit with individual battery fast-disconnects.

(5) Local display of power system status, UPS information, system status.

(6) Local and remote communications capabilities.

(7) An integrated PIM with external by-pass to support ease of connection.

(8) Be capable of accepting an *NTCIP*-ready adapter or a spread spectrum radio modem.

(9) A DB9F connector with true RS-232 monitoring and a USB connection for remote signal alarms and remote communications or one true RS-232 and five dry contact terminal blocks.

B. Provide a mounting/configuration that consists of a universal design. Provide a *NEMA* style mounting method that is accommodates shelf-mount or wall-mount, or rack-mount.

C. By-Pass Switch.

(1) Provide a by-pass switch that safely transfers utility power into the UPS.

(2) Provide a by-pass switch that contains a terminal strip for input and output power connections in addition to neutral and ground connections. Provide a terminal strip that includes six sets of independent auxiliary contacts or six dry contacts for flash, delayed flash and system monitoring functions. Auxiliary contacts may be mounted on the UPS and may consist of 5 dry contacts and 1, 48VDC contact to power an enclosure fan.

Ensure the by-pass switch is capable of connection to auxiliary power generators and provides a ground fault interrupter (GFI) outlet, or a standard 5-15R outlet. The generator transfer switch may be a separate Automatic Transfer Switch module, or a manual transfer switch mounted on the enclosure.

D. Battery System.

(1) Provide a battery system that is comprised of extreme temperature, deep cycle, or float cycle, absorbed glass mat (AGM) or gel cell valve regulated lead acid (VRLA). Ensure batteries are certified to operate at temperatures from -40 degrees Celsius (C) to +71 degrees C.

(2) Provide a battery system that has a minimum of 8 hours run time in the event of an AC power failure for an intersection operating with LED signals.

(3) Provide batteries that are certified to operate at extreme temperatures -40 degrees Fahrenheit (F) (-40 degrees C) to 160 degrees F (71 degrees C) and do not require any aid from external devices to cool or heat the batteries.

(4) Provide batteries with keyed interconnect wiring harness, a minimum of five feet in length.

(5) Provide an interconnect wiring harness cable that is protected with abrasion-resistant nylon sheathing and connects to the base module via a quick-release circular connector, or battery cable kit with Anderson Power style fast disconnect connector to UPS and individual battery fast disconnects.

(6) Provide a circular battery connector that has interlocking pins to prevent turn-on if batteries are not connected, and will shut off the UPS should the batteries be disconnected, or have a battery alarm that indicates the batteries are not connected.

(7) Ensure the battery construction includes heavy-duty, inter-cell connections for low impedance between cells, and heavy-duty plates to withstand shock and vibration. Ensure batteries provide 100 percent runtime capacity out-of-box. Each battery must meet its specification without the requirement of cycling upon initial installation and after the initial 24-hour top off charge.

(8) Ensure the top cover uses tongue and groove type construction and is epoxied to the battery case for maximum strength and durability.

(9) Provide an external, stand-alone (base) pad or pole mounted outdoor cabinet enclosure to house the UPS system as indicated on the plans. For the base mounted cabinet option, provide a 15 inch minimum cabinet base riser. Ensure the cabinet includes adequate shelves to house the UPS and batteries. Ensure the cabinet includes a connection to interface with an auxiliary power generator should there be a power outage lasting longer that the run time of the UPS. Ensure the auxiliary generator connection is accessible from the outside of the cabinet enclosure. Alternatively, provide a cabinet that has dimensions of 22 inches by 16.5 inches by 48 inches high and provides sliding (pull out) battery shelves that lock into position. Ensure the cabinet can house the UPS, transfer switch and batteries and is equipped with flush-mount generator plug door. The pad-mount pedestal option must be 22 inches by 16.5 inches by 8 inches high.

3. Electrical Specifications.

Table 1: Input Voltage

Nominal Input Voltage	120 VAC, Single Phase
DC Battery Buss	48VDC, 72VDC or 96VDC
Input Voltage Range	85 VAC to 135 VAC for Double conversion or Line-Interactive input range 85 VAC to 175 VAC
Input Frequency	45 - 62 Hz (±5 percent)
Input Configuration	3 Wire (Hot, Neutral, Ground)
Input Current (Max. draw)	8.8 amps, PFC-1250VA or 14.6 amps, PFC-2000VA. Line-Interactive 1100 VA/W unit 15.5 amps and 2000 VA/W unit 20 amps
Input Protection	Input Fuse (20 amps) or circuit breaker. The circuit breaker on the 2000W/2000VA UPS must be 25 amps.

Table 2: Output Specification

Nominal Output Voltage	120VAC, Single Phase
Power Rating	1250VA/825W or 1100VA/1100W continuous 2000VA/1400W or 2000VA/2000W continuous
Output Voltage Regulation	± 2 percent for 100 percent step load change and from High battery to Low battery condition in inverter operation
Output Frequency	50 or 60 Hz (±5 percent)
Output Configuration	Keyed, circular connectors and duplex receptacle or finger safe terminal block.
Output Wave Form	True Sine-wave
Overload capability	110 percent for 10 seconds 200 percent for 50 milliseconds
Fault clearing	Current limit and automatic shutdown
Short circuit protection	Current limit and automatic shutdown
Efficiency	92 percent at full load. Line-Interactive units 98% in line mode and 83% in inverter mode.
Load Power Factor	0.7 lagging through unity to 0.7 leading

4. Physical Specifications. Ensure module is no greater than:

A. Rack, Shelf and Wall Mount: Width = 19 inches, Depth = 10 inches, Height = 3.50 inches

B. By-Pass Switch: Width = 7 inches, Depth = 6 inches, Height = 4.5 inches

C. Weight: UPS: 35 pounds or less, Shipping weight: 40 pounds or less

5. Environmental Specification.

A. Provide a UPS system, including batteries, that meets or exceeds *NEMA* operating temperature standards from -40 degrees F (-40 degrees C) to 165 degrees F (74 degrees C) during discharge.

B. Provide a UPS system, including batteries, that is certified and field proven to meet or exceed *NEMA* temperature standards. Provide a certificate of compliance, from an independent testing facility, as requested by the Engineer.

6. Battery Specifications.

A. Provide batteries that are the 41, 51, 80, 86, 100, 109 or 112 Ampere-Hour rating type.

B. Provide batteries that meet *MIL SPEC B-8565J* for hydrogen gas emissions or VRLA batteries designed to provide up to 99 percent recombination of hydrogen gas under normal charging conditions.

7. Communication, Controls, and Diagnostics.

A. Provide alarm function monitoring through the UPS by using a standard DB-9F connector with open collectors (40V at 20 milli-Ampere) or dry contact terminal blocks indicating:

(1) Battery On;

(2) Time Out Battery On Alarm;

(3) Low battery; and

(4) Alarm.

B. Provide both an RS-232 interface via a DB-9F connector and a USB connection to allow full interactive remote computer monitoring and control of the UPS function.

C. Provide front panel controls that consist of no less than: Power On, Cold direct current (DC) Start, Alarm Silence, Battery Test, UPS Self-Test, and DC/Battery Breaker.

D. Provide a UPS that is programmable through a front panel keypad.

8. Reliability.

A. Ensure the calculated Mean Time Between Failures (MTBF) is 100,000 hours based on component ratings or for a line-interactive system the UPS system must have a Mean-Time-Before-Failure (MTBF) of 174,955 hours at a temperature of 25 degrees C (77 degrees F) and 103,030 hours at a temperature of 50 degrees C (122 degrees F) per *Telcordia SR-232*, 100 percent duty cycle, full load.

B. Ensure when the by-pass switch is included, the system MTBF increases to 150,000 hours.

9. Options.

A. Provide a UPS-link, internally mounted simple transportation management protocol (STMP)/NTCIP adaptor.

B. Ensure that extended run times are possible via additional batteries.

C. Provide a high rate battery charger for accelerated charging capacity for multiple battery strings. The high rate battery charger must be 15ADC with the line-interactive true UPS.

10. Serviceability and Maintainability.

A. Mean-Time-To-Replace or Repair (MTTR)

(1) Electronics: 15 minutes or less

(2) Battery System: 15 minutes or less

11. Warranty. Provide materials with a manufacturer’s warranty/guarantee of 4 years

minimum, transferable to MDOT, that the supplied materials will be free from all defects in materials and workmanship. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance.

c. Construction. Complete this work in accordance with sections 204, 819 and 820 of the Standard Specifications for Construction, as shown on the plans and as directed by the Engineer.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Traffic Signal Power Backup System	Each

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

FIBER OPTICS

a. Description. This work consists of furnishing, installing, splicing, and testing single mode fiber optic cable and fiber optic communications hardware.

b. Materials.

1. Fiber Optic, Cable - Outside Plant (OSP).

A. Provide cable listed in the latest edition of the Rural Development Utilities Program (RDUP, formerly RUS) List of Materials Acceptable for Use on Telecommunications Systems.

B. Provide single mode, loose tube, gel free, non-armored fiber optic cable.

C. Provide cable constructed with 12 fibers per buffer tube.

D. Provide cable meeting the following environmental conditions:

(1) Storage. -40 degrees Fahrenheit (F) to +158 degrees F;

(2) Installation. -20 degrees F to +140 degrees F;

(3) Operation. -40 degrees F to +158 degrees F.

E. Provide cable with maximum attenuation of 0.35 decibels per kilometer (dB/km) maximum at a wavelength of 1310 nanometers (nm) and attenuation of 0.25 dB/km maximum at a wavelength of 1550 nm.

F. Show the date of manufacturer and the manufacturer's name as a permanent marking on the outer jacket. Mark a numerical sequence on the jacket at intervals no greater than 3 feet to facilitate determination of length of cable and amount of cable remaining on the reel. Ensure the height of the marking is a minimum of 0.08 inch nominal. In addition, the cable must have permanent markings as indicated on the plans or in the contract.

G. Ensure the cable designated for "Partner Agency Cable," if required, is color coded as shown on the plans.

Deliver the cable on reels without splices. Ensure both ends of the cable are sealed to prevent moisture ingress.

2. *Fiber Optic, Marker, Above Ground, Modified.*

Ensure the above-ground portion of the marker is made entirely of Polypropylene or high-density polyethylene (HDPE) and is protected against damage from ultraviolet (UV) light. Ensure the marker is hollow, white, and 6 feet long. Ensure its diameter is at least 3.5 inches and its wall thickness is at least 0.125 inches. Ensure the top of the marker is covered with an orange outer tube that has a domed top, nominally 16 inches in height. Ensure the marker has a physical mechanism made of HDPE or galvanized steel to anchor the marker to the ground and prevent uplift.

Ensure that black lettering is printed on, or molded into, both sides of the top of the marker saying "CITY OF KALAMAZOO FIBER OPTIC CABLE ROUTE"; decals are prohibited. Guarantee this lettering not to fade for the life of the marker. Ensure the lettering is approximately 1 inch high, with a 0.2 inch stroke width. In smaller letters, the printing must say "BEFORE DIGGING, CALL MISS DIG 811." Ensure the proposed size and layout of all text is submitted to the Engineer for approval as part of the catalog cut sheet for this item.

3. *Fiber Optic, Cable, Indoor*.

Provide indoor-rated fiber optic cable and all hardware required for splicing indoor/outdoor cables and to facilitate cable installation. Ensure fiber capacity is as indicated on the plans.

A. Provide Plenum-rated, flame resistant single mode fiber optic cable.

B. Ensure the cable has 12 fibers per buffer tube.

C. Provide non-armored cable.

D. Ensure the indoor single mode cable has a maximum attenuation of 0.35 dB/km at 1310 nm wavelength and 0.25 dB/km at 1550 nm wavelength.

E. Provide cable that meets the following environmental conditions:

(1) Storage. -40 degrees F to +158 degrees F;

(2) Installation. +32 degrees F to +140 degrees F;

(3) Operation. +32 degrees F to +158 degrees F.

4. *Fiber Optic Connectors*.

Provide type LC fiber optic connectors for pigtails and type LC-to-LC connectors for jumper cables. Ensure connectors are comprised of a ceramic ferrule with a nickel plated zinc or composite connector body. Ensure the average loss is 0.3 decibel (dB) or less.

5. *Fiber Optic, Pigtail, Modified*.

A. Ensure pigtails are factory-made, buffered, and strengthened with aramid yarn to reduce the possibility that accidental mishandling will damage the fiber or connection.

B. Ensure pigtails are yellow

C. Ensure they use the type of connector specified in subsection b.4 of this special provision and are factory terminated.

D. Ensure each pigtail contains one or two fibers (simplex or duplex). Provide lengths sufficient to provide 2 feet of slack after installation.

6. Fiber Optic, Jumper, Modified.

A. Ensure jumpers meet the requirements for pigtails and have a connector on each end of the appropriate type.

B. Provide lengths that ensure sufficient slack after installation to avoid undue force on connectors and to facilitate the ease of maintenance work.

7. *Fiber Optic, Hardware Assembly, Small, Modified*.

Provide a small (up to 48 fibers) rack- mounted interconnect center with built-in patch panel, splice enclosure, splice trays, and all splicing hardware.

A. An interconnect center is defined herein as a splice and termination enclosure, that houses the internal patch panel for fiber termination via fiber optic pigtail. Ensure the interconnect center is capable of housing the splice trays for fiber optic splicing.

B. Ensure the interconnect center enclosure has brackets and all other hardware required for rack mounting in an Electronic Industries Alliance (EIA) standard 19-inch equipment rack. Ensure it takes up no more than one rack unit (RU) (1% inch) in the cabinet. Ensure it has front and rear doors. Ensure it is made of powder-coated aluminum or 16-guage steel.

C. Provide enough trays for all splices made in the interconnect center. Ensure the interconnect center enclosure's patch panel has at least 24 positions, compatible with the connectors specified in subsection b.4 of this special provision. Ensure it has provisions for cable strain relief and for connector labeling.

D. Hold the spliced fibers in splice trays, with each fiber neatly secured to the tray. Ensure the splice trays are compatible with the fiber optic splices specified herein and meets the following minimum requirements:

(1) Ensure the tray can accommodate loose tube buffers;

(2) Ensure slack fiber within the tray is placed neatly in an oval shape along an inside wall of the tray;

(3) Provide splice trays made of power-coated aluminum or high density plastic. Ensure the trays are designed for outdoor use.

8. *Fiber Optic, Hardware Assembly, Medium, Modified*.

Provide a medium (up to 96 fibers) rackmounted interconnect center per requirements in subsection b.8 of this special provision. Ensure it takes up no more than two rack units in the cabinet.

9. *Fiber Optic, Hardware Assembly, Large, Modified.*

Provide a large (up to 288 fibers) rackmounted interconnect center per requirements in subsection b.8 of this special provision. Ensure it takes up no more than four RU in the cabinet.

10. Fiber Optic, Storage Cabinet, Wall-Mounted, Modified.

A. Provide a wall-mounted fiber optic storage cabinet for storage of fiber optic slack cable during initial installation and future cable management.

B. Ensure the storage cabinet has at least four cable entry holes.

C. Size the storage cabinet to accommodate at minimum 500 feet of fiber optic cable slack.

D. Design the storage cabinet for indoor use. Ensure the cabinet has a powder-coat finish and is made of aluminum.

11. *Fiber Optic, Splice Cabinet, Modified.*

Provide splice cabinets at locations shown on the plans.

A. Provide a fiber optic splice cabinet that meets NEMA 3R requirements with minimum dimensions of 46 inches high by 24 inches wide by 20 inches deep. Ensure the cabinet is furnished with an EIA standard 19-inch equipment rack and is fully compatible with the rack-mounted interconnect centers.

B. Design the fiber optic splice cabinet to be mounted on a pedestal as shown on the plans.

C. Ensure the foundation and pedestal for the splice cabinet conforms to the requirements for traffic signal pedestals in sections 820 and 921 of the Standard Specifications for Construction

D. Construct all cabinets from 1/8 inch 5052 aluminum. Provide a cabinet with a white polyester powder coat finish.

E. Provide an engraved plaque on the front door, displaying the cabinet ID indicated on the plans. Ensure characters are at least 4 inches high with a minimum stroke width of 0.4 inches unless smaller characters are required to fit the ID on one line. Provide a plaque made of multilayered plastic with a black surface over a white interior; the engraving will reveal the white interior.

F. Provide continuous gas tungsten arc (TIG) welding for all external welds. Use the gas metal arc (MIG) or TIG welding method for all internal welds.

G. Provide two removable lifting eyes, each rated to 1,000 pounds, on either side of the top of the cabinet. Ensure each eye has a minimum internal diameter of 3/4 inch.

H. Doors.

(1) Ensure front and rear access doors are of same metal grade and finish as the cabinet body.

(2) Hinges are to be approximately 1/8 inch stainless steel piano hinge or continuous door length stainless steel hinges to provide a rigid and strong door construction.

(3) Ensure hinge pin stops are welded on top and bottom to prevent tampering.

(4) Mount hinges on internal side of door, so that hinges cannot be removed without first opening the door.

(5) Ensure the two-position door stop allows the door to remain open at the 90 degree position and at the 120 or 180 degree positions.

(6) Mount the door stop to the top or bottom of the door.

(7) Ensure each door has a 3-point locking/latching mechanism.

(a) Provide three latch points - center, top, and bottom of each door.

(b) Ensure that the latch points do not move until the cabinet door is unlocked.

(c) Use stainless steel locking bars for the top and bottom latch points capable of resisting manual prying.

(d) Provide nylon rollers on the top and bottom locking bar ends.

(e) Provide an industrial standard pin tumbler lock (Corbin lock), keyed #2, with two keys per locking mechanism.

(f) Door handle and locking mechanism may be separate.

(g) Provide locking eyes on handle and door, for each door such that a padlock may be installed.

I. Provide a louvered vent near the bottom of each door capable of deflecting water and directing incoming air downward towards the bottom of the cabinet. Provide a reusable-washable filter that will be placed inside the door vents.

J. Provide R-4 insulation on interior sides, top, and both doors.

12. *Tracer Wire, Modified*.

A. Provide fiber optic tracer wire at locations as indicated on the plans and as directed by the Engineer.

B. Ensure the tracer wire is a single conductor solid copper, American Wire Gauge (AWG) 14/1, gauge size 14, underground, UL Rated.

C. Insulate the tracer wire using High Molecular Weight Polyethylene (HMWPE) meeting ASTM D 1248 or High-Density Polyethylene (HDPE) as approved by the Engineer and be an orange jacket color.

D. Ensure wire connectors are 3M DBR, IDEAL UnderGround, or approved equal,

E. and are watertight to provide electrical continuity.

F. Ensure the tracer wire is accessed/connectorized from each handhole.

G. Install minimum 6 feet tracer wire slack at each head end of tracer wire.

c. Construction.

1. *Cable Pulling*.

A. Install the cable such that the optical and mechanical characteristics of the fiber are not degraded.

B. Do not violate the minimum bend radius or the maximum tension, both during and after installation. Corner rollers (wheels), if used, must not have radii less than the minimum installation bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturer specifically approves the array.

C. Use a clutch device to ensure the allowable pulling tension is not exceeded, if the cable is pulled by mechanical means. Also, attach a strain gauge to the pulling line at the cable exit location, and at a sufficient distance from the take-up device such that the strain gauge can be read throughout the entire cable pulling operation.

D. Do not leave the let-off reel unattended during a pull to minimize the chance of applying excess force, center pull, or back feeding.

E. Use entry guide chutes to guide the cable into the pull-box conduit ports.

F. Only lubricants approved by the cable manufacturer are permitted. Wipe the exposed cable in a pull box, junction box, or cabinet clean of cable lubricant with a cloth, after the cable has been installed.

G. Use separate grooved rollers for each cable, when simultaneously pulling fiber optic cable with other cables.

H. Seal the fiber optic cable ends to prevent the entry of water.

I. Install above ground fiber optic markers every 500 feet and also where the cable changes direction.

J. Install fiber optic tracer wire at locations as indicated on the plans.

2. *Cable Slack Requirements*.

Throughout the cable plant, pull and store excess cable slack at designated intervals. These intervals must occur at each handhole. The following lengths of slack cable are minimums:

A. HH, Round, 3 foot diameter (36 inches) 50 feet

B. HH, Type D 100 feet

3. *Optical Splicing Requirements*.

   A. Use a fusion splicer that automatically positions the fibers using the Light Injection and Detection (LID) system when making splices.

   B. Package each spliced fiber in a heat-shrinkable splice protection sleeve with strength member. Cover the splice and any bare fiber stripped of its coating with the protective sleeve. Completely re-coat bare fibers with a protective gel or similar substance, prior to application of the sleeve or housing to protect the fiber from scoring, dirt, or microbending. The use of Room Temperature Vulcanizing (RTV) or silicone sealants is strictly prohibited.

   C. Do not splice fibers from a given buffer tube in multiple splice trays.

   D. Furnish and install a fiber optic splice cabinet for end-to-end fusion splicing and at other locations shown on the plans. End-to-end splicing at locations not shown on the plans is permitted only when cable distance exceeds maximum reel length and must be approved by the Engineer. Pull cables into splice cabinet such that the bending radius of the fiber is not compromised.

   E. No splice is acceptable with an attenuation of greater than 0.06 dB. Test all fibers spliced, end-to-end once all fibers have been terminated, unless otherwise indicated on the plans. If a splice is measured to exceed 0.06 dB during the splicing process, it must be remade until its loss falls below 0.06 dB, unless otherwise approved by the Engineer. Record each attempt for purposes of acceptance.

   F. Terminate fibers by splicing them to factory-made pigtails or matching fibers as shown on the plans. Cap all connectors that are not connected to a mating connector.

4. *Fiber Acceptance Testing*.

   A. The basis of fiber acceptance is testing using an optical loss test set (OLTS).

   B. Test the fiber after installation, including all splicing and termination, is complete. Note, however, that this test procedure involves measuring the optical loss of any fiber installed by others, prior to splicing to it.

   C. For each fiber optic link, including spare fibers, determine whether the optical loss is within the limits permitted by this special provision. A link is defined as a continuous segment of fiber between one connector and another connector.

   D. When testing links that do not have connectors on both ends, use a mechanical splice to attach a pigtail to the unterminated fiber for the duration of the test. Mechanical splices will not be measured for separate payment.

   E. For each fiber link, follow this procedure:

      (1) If the link includes fiber installed by others, measure and record the optical loss over that portion of the link before it is spliced to new fiber.

      (2) Calculate the maximum allowable loss for the completed link, both at 1310 nm and 1550 nm. Use the following formula:

MAL = MLL + OFL + FSL + MSL + CL

Where:

MAL = Maximum Allowable Loss (calculate at both 1310 nm and 1550

nm) MLL = Maximum Link Loss for cable portions installed by others

OFL = Outdoor Fiber Length in km times (0.35 dB for 1310 nm and 0.25 dB for 1550 nm)

FSL = Number of fusion splices times 0.06 dB

MSL = Number of mechanical splices times 0.3

dB CL = Number of Connections times 0.3 dB

Provide this calculation to the Engineer along with the test results.

(3) Calibrate an OLTS and provide evidence satisfactory to the Engineer that the set produces accurate results at both wavelengths. This can be a demonstration that the set correctly measures the loss of a test fiber whose loss is known.

(4) Use the OLTS to measure the loss of the link under test. Record the results at both 1310 nm and 1550 nm, and submit a summary to the Engineer in a tabulated format.

(5) If the measured loss exceeds the calculated maximum, use an Optical Time Domain Reflectometer (OTDR) and other test equipment to troubleshoot the link. Take whatever corrective action is required, including cable replacement, to achieve a loss less than the calculated maximum.

F. Fiber Optic Tracer Wire Testing.

(1) Perform a continuity test on all tracer wire. If the tracer wire is found to be not continuous after testing, repair or replace the failed segment of the wire.

(2) Perform the test using a transmitter and tracer provided by the City, or approved equal. Arrange for the test to be witnessed by the Engineer.

5. *Documentation*.

Prepare a diagram showing all the links tested in this project. For the portions installed in this project, show the equipment cabinets, splices, and pigtails. On each line representing a link, show the maximum allowable loss and the actual loss. Ensure the actual loss is the one measured after all corrective actions have been taken. If required by the plans, provide an OTDR trace for all fibers to document the location of the sources of optical loss in the cable.

6. *Warranty.*

   Provide all fiber optic equipment covered by this special provision with a standard manufacturer's warranty. All the fiber optic equipment covered by this special provision must carry a warranty (parts and labor) of 1 year from the date of shipment. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final acceptance.

d. Measurement and Payment.

The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item Pay Unit

Fiber Optic, Cable, Single Mode Fiber, 12F, Modified..... Foot
Fiber Optic, Pigtail, Modified..... Each
Fiber Optic, Hardware Assembly, Small, Modified..... Each
Tracer Wire, Modified..... Foot

1. **Fiber Optic, Cable, Single Mode Fiber, 12F, Modified** includes furnishing and installing outdoor-rated fiber optic cable and all fusion splicing as shown on the plans. Number of fibers will be as indicated on the plans.

2. **Fiber Optic, Pigtail, Modified** includes furnishing and installing a single mode fiber pigtail and includes the associated fusion splicing.

3. **Fiber Optic, Hardware Assembly, Small, Modified** includes furnishing and installing a small (up to 48 fibers) rack-mounted interconnect center (includes built in patch panel, splice enclosure, and splice trays).

4. **Tracer Wire, Modified** includes furnishing, installing, and testing tracer wire at locations as described and/or shown on the plans.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
VERTICAL EXPLORATORY INVESTIGATION FOR RELOCATION

COS:MRB 1 of 2 APPR:DMG:NAL:04-30-20
FHWA:APPR:05-06-20

a. Description. When proposed work must be relocated as directed by the Engineer, this special provision is used to compensate the Contractor to locate and expose underground infrastructure and obstructions, such as culverts, sewers and utilities. Perform this work only when conflicts are found in the planned work location. This special provision is not to compensate for the Contractor's responsibilities in subsection 107.12 of the Standard Specifications for Construction.

b. Materials. Use Granular Material Class III in accordance with section 902 of the Standard Specifications for Construction for backfill. Use material removed during exploratory investigation for backfill only if approved by the Engineer.

c. Construction. The owner of any sewer or utility to be exposed will not take the facilities out of service during the exploratory investigation. Contact utility owners in accordance with subsection 107.12 of the Standard Specifications for Construction.

Advance the exploratory excavation using vacuum excavation, hand digging, conventional machine excavation, or a combination thereof subject to approval of the Engineer. Allow the Engineer access to document the necessary information. If the technique used to advance the excavation causes any damage to the existing facilities, immediately contact the utility owner and cease all work until an alternate method is approved by the Engineer.

Take care to protect the exposed culvert, sewer or utility from damage during construction. The Contractor is responsible for all costs associated with the repair work and out of service time of all broken or damaged existing culverts, sewers or utilities as a result of any action by the Contractor. If the exploratory investigation results in damage to utilities, contact the owner of such utility to coordinate the repair. Repair or replace culvert, sewer or utility, damaged during exploratory excavation, in accordance with the standard specifications and as approved by the Engineer.

Obtain the Engineer's approval before backfilling the excavation. Complete backfilling no later than 24 hours after approval has been given. Backfill in accordance with subsection 204.03.C of the Standard Specifications for Construction. Dispose of excess material in accordance with the standard specifications.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Exploratory Investigation, Vertical	Foot

Exploratory Investigation, Vertical will be measured by the foot from top of existing grade vertically to the bottom of the excavation for up to a 4-foot maximum diameter hole, or as approved by the Engineer. The excavated depth of each 4-foot maximum diameter hole will be measured separately for payment.

Exploratory Investigation, Vertical includes all costs associated with repair or replacement resulting from the Contractor's activities. Providing necessary lane, shoulder and/or sidewalk closures required to perform work will be paid for by other associated items in the contract. Restoration work will be paid for by other associated items.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
LUMINAIRE, ROADWAY

a. Description. This work consists of installing luminaires as shown in the contract. Ensure all work is in accordance with the standard specifications, the *NEC*, as specified herein, and as shown on the plans.

b. Materials. Furnish luminaire assemblies by one of the following pre-approved Manufacturers meeting all *ANSI/NEMA/UL/IES* applicable codes, including the following requirements:

1. Towers/Median.

    - CREE OSQ.
    - Holophane HMAO LED3.
    - Streetworks Galleon.
    - Lumecon Detroit series LLC.

2. Ramps/Round-a-bouts.

    - CREE XSP2.
    - Holophane Autobahn.
    - Streetworks – Archeon/NVN Navion.
    - Lumecon Detroit series LLC

Ensure the entire luminaire assembly including the housing, driver, and optical components, are manufactured and assembled in the United States of America. Ensure the luminaire housing and optical assembly are furnished by the same manufacturer.

Ensure luminaire housing is *Independent Electrical Contractors (IEC) ingress protection 66* rated, die-cast aluminum construction with stainless steel or zinc plated steel fastening hardware. Ensure the fixture is a grey or silver powder-coat finish unless otherwise shown in the contract. Furnish a mast arm horizontal tenon mounting provision with ±5 degree leveling adjustment capable of mounting on a 2-inch (2⅜ inch outside diameter) pipe arm (if required). Ensure the fixture has passive heat sink cooling (no fans, pumps, etc.) with self-cleaning ability and designed to operate within a -40 °F to 140 °F ambient temperature environment.

Furnish the luminaire optical assembly with a color temperature between 4000 kelvin (K) and 5000K, with a color rendering index (CRI) of 70 or greater and with an *IES* photometric distribution as specified in the contract. Ensure the luminaires' driver/ballast is solid-state type (*ANSI/NEMA/American Nation Standard Lighting Group {ANSLG} C78.377*) with built-in overload and voltage surge protection. Ensure the driver/ballast has a 90 percent or greater power factor with less than 20 percent total harmonic distortion at full load and input voltage as shown in the contract. Ensure the drivers/ballasts have a minimum rated useful life of 100,000 hours and

comply with *FCC 47 CFR part 15* non-consumer rules and regulations.

Furnish luminaires with a minimum 10 kilovolt (kV)/10 kiloampere (kA) replaceable internal surge suppression module meeting *UL 1449*/*ANSI C62.41.2 Category C*, high exposure requirements. Ensure the luminaire power supply, driver/ballast, optical assembly, and surge suppression module is field serviceable and upgradable by means of modular electrical connections and easy access mounting hardware. Install luminaire busman fusing inside pole base handhole as shown on detail sheet.

Ensure the luminaire conforms with *ANSI C136.31/37* for 3G rating of vibration for bridge and overpass applications, *ASTM B117* for Salt Spray (Fog) testing (Minimum 3000 hours), and *IES TM-15* for Backlight, Uplight, and Glare (BUG) ratings, without resorting to additional shields being attached to luminaire housing.

Ensure the luminaire delivers 90 percent or greater initial delivered lumens after 50,000 hours of operation and has a 70 percent or greater lumen maintenance after a minimum of 100,000 hours rated life. Furnish the Engineer the luminaire life expectancy rating (L70), manufacturer's documentation and photometric data per *IES-LM-80* calculated at an ambient temperature of 25 °C, by a third-party independent test lab recognized by the Department of Energy as qualified to conduct photometric testing per *IES LM-79*.

Ensure the luminaire has a minimum 10-year manufacturer's written warranty covering luminaire assembly, electrical components, driver, mechanical components, and paint finish.

The Engineer reserves the right to request standard production model fixture samples for inspection and to require such tests as deemed necessary to ensure complete compliance with the specifications. Luminaires that do not meet these tests or those luminaires with improper or inadequate light distribution are subject to rejection. All costs associated with submitting and testing of replacement luminaires or lamps due to rejection of submitted luminaires are the responsibility of the Contractor.

c. Construction. All new installations must have luminaires furnished as shown in the contract. Examine all luminaires delivered to the jobsite prior to installation to ensure all specification requirements and shop drawing comments have been incorporated by the manufacturer. Ensure luminaires are individually packed for shipment in such a way as to ensure arrival at their destination in an undamaged condition.

Furnish shop drawings showing luminaire type, driver/ballast specification sheets, and photometric calculations. Submit as complete package.

Ensure all luminaire assemblies are furnished by one manufacturer. Any proposed luminaire must achieve the photometric levels and uniformity ratios per *IES LM-79* for the fixture spacing shown in the contract. Submit project specific point-by-point lighting footcandle calculations by an independent third-party testing lab, meeting the following design criteria:

Ensure candle power distribution is in accordance with the *2020 AASHTO Roadway Lighting Design Guide* criteria as follows: Average maintained illumination level of at least 1.0 footcandle and minimum maintained illumination level of at least 0.2 footcandles with a uniformity ratio (Average/Minimum Footcandles) not exceeding 4:1.

Ensure road surface classification is "R3" unless otherwise noted, with the light loss factor

determined by manufacturer's lumen maintenance depreciation calculated at 55,000 hours (~12 years dusk-to-dawn operation), lumen dirt depreciation of 0.90. (LLF=LM*0.90)

Ensure luminaries are oriented to furnish optimum designed light level distribution on the roadway.

Clean the luminaire reflector and glassware after installation is complete. Ensure cleaning is done in accordance with the luminaire manufacturer's recommendations.

Furnish manufacturers calculations and supporting test data indicating lumen maintenance life and product warranty documentation to the Engineer. Ensure final photometric calculations are based on lumen photopic values; scotopic lumen values are not recognized.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Luminaire, (location)	Each

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
PRECAST CONCRETE PEDESTAL SIGNAL FOUNDATION AND PRECAST UNDERGROUND SERVICE PEDESTAL (METAL) FOUNDATION

STR:POJ 1 of 1 APPR:RWS:MJF:06-02-20
FHWA:APPR:06-04-20

a. Description. This work consists of fabricating, furnishing, and installing precast concrete foundations to be used for pedestal pedestrian signals and underground service pedestals (metal), as shown in the contract, and in accordance with the standard specifications except as modified herein.

b. Materials.

1. Concrete. Use concrete grade 3500 or 3500HP in accordance with section 1004 of the Standard Specifications for Construction.

2. Anchor bolts. Use *ASTM F1554 Grade 36*.

3. Reinforcing Steel. Must meet section 905 of the Standard Specifications for Construction.

4. Open-Graded Aggregate, 34R.

c. Fabrication. Fabricate at a commercial precast facility certified by *Precast/Prestress Concrete Institute (PCI)*, *National Precast Concrete Association (NPCA)*, or *American Concrete Pipe Association (ACPA)*. Provide quality control and notify the Engineer prior to fabrication to provide the opportunity for quality assurance inspection. The Engineer may elect to forego this inspection but not the certification requirements. Provide steel reinforcement as necessary to protect foundations from any shipping, handling, or installation damage. Precast foundations are subject to rejection by the Engineer for visible damage or improper material documentation during fabrication and at time of delivery and installation.

d. Construction. Ensure precast pedestal signal foundations are placed plumb and level in the excavation on 6 inches of 34R open-graded aggregate, with an annular space of 3-6 inches. Fill the annular space with 34R in one-foot lifts and compact each lift. Restore disturbed areas in kind in accordance with section 816.

e. Measurement and Payment. The completed work, as described, will not be paid for separately but will be included in the associated pay item(s) covered in subsection 820.04 of the Standard Specifications for Construction.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
ACCESSIBLE PEDESTRIAN SIGNAL SYSTEM

SIG:EMS 1 of 6 APPR:HLO:NJB:05-01-20
FHWA:APPR:05-06-20

a. Description. This work consists of either furnishing and installing an accessible pedestrian signal system and push button station(s), or removing a system and station(s) at locations as shown on the plans.

The following terminology is used in this special provision.

1. Accessible pedestrian signal system, or system hereafter, refers to central control unit (CCU) and multiple push button stations.

2. CCU, refers to the unit installed in an existing traffic signal controller cabinet, frame, and all required mounting hardware and the configurator. The CCU is the power supply and signaling interface, between the intersection traffic signal controller and the push button stations. Configurator refers to a handheld, password secure, infrared device capable of setting and resetting all push button stations on the intersection from a single push button station (global updating). Each CCU will control multiple push button stations. A complete system includes one CCU.

3. Push button station (PBS), refers to a Public Rights of Way Accessibility Guidelines (PROWAG) compliant push button station including signs when specified, installed at crosswalk termini, and all required mounting hardware. A system can include 2 to 12 PBS (maximum of 3 per phase).

b. Materials. Provide a Polara Navigator system including CCU and PBS, or approved equal, meeting the requirements of this subsection. Provide all hardware and other appurtenant materials in accordance with sections 918 and 921 of the Standard Specifications for Construction and this special provision.

1. The system must:

A. Provide various audible features including but not limited to locator tones. All locator tones must emanate from push button stations and be synchronized;

B. Have multiple language capability, selectable by user, and able to play an emergency preemption message;

C. Be able to self-test and report any faults to the traffic controller;

D. Provide the following audible feature, each with a minimum and maximum volume independently settable using the configurator:

(1) One locating tone;

(2) Five walk sound choices (field selectable);

(3) Three pedestrian - clearance sound choices (field selectable) one of which must be an audible countdown;

(4) Direction of travel (as standard feature with extended push); and

(5) Information message (custom feature with extended push).

E. Automatically adjust audible features to ambient noise levels over a 60 decibel (dB) range; and

F. Mute sounds on all crosswalks except the activated crosswalk (selectable feature).

2. The CCU must meet the following requirements:

A. Be compatible with solid-state pre-timed or actuated traffic signal control equipment and cabinet environments;

B. Be capable of controlling up to and including 12 PBSs and controlling up to and including 4 pedestrian phases;

C. Receive timing from the walk and don't walk signals;

D. Have additional advanced configurations available by using general purpose inputs and outputs;

E. Ensure full optical isolation of all inputs and outputs and include transient voltage protection as follows:

(1) General Purpose Inputs. 10 to 36 Volts (V) Alternating Current/Direct Current (AC/DC) peak with a 10 milli Ampere (mA) maximum.

(2) General Purpose Outputs and Pedestrian Outputs. 36V AC/DC peak, 0.3 Ampere (A) solid state fused contact closure.

(3) Fault Output. Normally open and closed relay contacts, 125V AC/DC, 1A maximum.

(4) Pedestrian Hand/Walking Person (Walk/Don't Walk) Inputs. 80-150V AC/DC, 5mA maximum.

(5) A, B, C, D PBS Power Outputs. Nominal 22V DC, short circuit protected, auto recovering.

(6) Environment Operation and Storage Range. -30 degrees Fahrenheit (F) to 165 degrees F (-35 degrees Celsius (C) to 74 degrees C), 0 to 100 percent Humidity, Non-condensing.

(7) Line Power. 25 Watt (W) to 75W typical, 120W peak with 8 PBSs.

F. Include a 50-pin connector and cable that plugs into the CCU for termination to the traffic signal controller terminal facilities. Ensure the connector is a Positronic MD50F20Z0X or equivalent, provided with 20-24 gauge wire, which complies with the requirements of *UL 1061*.

3. The PBS must meet the following requirements:

A. Design each PBS in accordance with the following:

(1) Produce sounds emanating from the back of the unit via an 8 ohms 15W, weather-proof speaker protected by a vandal resistant screen;

(2) Require only two wires coming from the traffic control cabinet for each phase/crosswalk;

(3) Include push buttons which are audibly locatable and equipped with tactile arrows pointing in the same direction as the associated crosswalk;

(4) PROWAG compliant, cast aluminum, nickel plated, powder coated with raised tactile arrow on button;

(5) Include solid-state switch rated to 20 million activations (minimum); and

(6) Include a two inch button with a tactile raised directional arrow on the button that can be changed to one of four directions to coincide with the direction of travel of the associated crosswalk.

B. The PBS must include the following standard features:

(1) The arrow/button must vibrate during the walk period, following a button push;

(2) Confirm a button push via a “vibratactile” bounce and a red light emitting diode (LED), clearly visible in direct sunlight, which latches ON when the button is pushed;

(3) Indicate the direction of travel with extended button push;

(4) Transmit a standard locating tone, custom sound, or verbal countdown during pedestrian clearance;

(5) Ensure sounds automatically adjust to ambient over 60 dB range;

(6) Allow sounds to have minimum and maximum volume set independently;

(7) Synchronize all sounds;

(8) Extended button push can turn on, boost volumes, and/or mute all sounds except those on activated crosswalk; and

(9) Include message to clear the intersection when preemption is activated.

C. Ensure the PBS is capable of custom message and sound options for the following features:

(1) Custom locating tone;

(2) Custom clearance sound;

(3) Custom walk sounds/message;

(4) Informational message;

(5) Multiple languages (up to three, selected by user); and

(6) Street name in Braille on the sign.

D. Ensure the PBS is fabricated in accordance with the following:

(1) Available in three standard colors: Black, Green, and Yellow. The default color is yellow unless specified otherwise;

(2) Have an operational temperature range of -40 degrees F to 165 degrees F (-40 degrees C to 60 degrees C);

(3) Ensure the housing material is cast aluminum;

(4) Chemically filmed and powder coated;

(5) Face plate constructed of powder coated aluminum with ink marking; and

(6) Have pre-drilled mounting holes to hold a 9 inch by 12 inch, R10-3b, 3d, or 3e pedestrian sign.

E. PBS LED display operational requirements:

(1) Light when the button is pushed and remain lit until the next walk phase.

(2) Luminous intensity greater than 1200 maximum continuous discharge (mcd), sunlight visible, ultra bright red, with a 160 degree viewing angle.

F. PBS audio operational requirements:

(1) Audio amplifier power output of 10W Root Mean Square (RMS) into 8 ohms.

(2) Volume control automatic adjustment range of 28dB (maximum).

(3) Microphone ambient noise frequency range of approximately 170 Hertz (Hz) to 2.3 Kilo Hertz (kHz).

(4) Button tone provides a brief “tick” to confirm each button push.

(5) Audible locating tone operates during the pedestrian-clearance and don't walk interval at an 880Hz plus harmonic, 0.1 second duration, 1 second interval.

(6) Audible "chirp" operates only during walk intervals at 2700Hz to 1700Hz, 0.2 second duration, 1 second interval.

(7) Audible "cuckoo" operates only during walk intervals at 1250Hz to 1000Hz, 0.6 second duration, 1.8 second interval.

4. Ensure the configurator meets the following requirements:

A. Be a handheld, password protected, remote that configures the CCU or an individual PBS;

B. Communicate via infrared technology with the CCU and the PBS with an interactive operation to select various configuration options at the intersection(s), by standing adjacent to either the CCU or a PBS;

C. Feature a liquid crystal display (LCD) display, with two 16-character lines, with backlight and adjustable contrast;

D. Be powered by four AA 1.5V cell batteries, include a low battery warning, and have an auto or manual shut-off switch; and

E. Have an operating temperature range of 32 degrees F to 122 degrees F (0 degrees C to 50 degrees C).

5. Warranty. Provide a manufacturer's warranty, transferable to the MDOT, that the supplied materials will be free from all defects in materials and workmanship for a 2-year period from the date of shipment. Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing date of shipment, to the Engineer at the time of delivery.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, typical signal construction details, and this special provision.

1. Furnish and Install. Furnish and install a system at an intersection as shown on the plans and in accordance with the *MMUTCD*. Ensure that the arrow on the PBS button(s) point in the direction of pedestrian travel for the associated crosswalk.

2. Remove. Remove an accessible pedestrian signal system or a push button station and store, as directed by the Engineer, or dispose of all removed materials.

A. Where removal of an accessible pedestrian signal system is specified on the plans, remove the CCU, hardware, cable, connectors, and other appurtenant material required to complete the work.

B. Where removal of a PBS is specified on the plans, remove the PBS, sign, associated assembly, hardware, cable, connectors, and other appurtenant material required to complete the work.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	Pay Unit
Pedestrian Signal System, Accessible	Each
Push Button Station	Each
Push Button Station and Sign	Each
Pedestrian Signal System, Accessible, Rem	Each
Push Button Station, Rem	Each

1. **Pedestrian Signal System, Accessible** includes installing the accessible pedestrian signal system at an intersection, including a CCU, configurator, hardware, fittings, conduit(s), wiring, grounding and ground rod(s), and all appurtenant material required to complete the work.

2. **Push Button Station** and **Push Button Station and Sign** includes installing the push button station, sign (when specified), associated assembly, brackets, hardwire, fittings, conduit(s), cable to controller, wiring, grounding, ground rod(s), and all other appurtenant material required to complete the work.

3. **Pedestrian Signal System, Accessible, Rem**, includes removing an accessible pedestrian signal system at an intersection including a CCU, configurator, hardware, fittings, hardware, cable, connectors, conduit(s), grounding, and other material required to complete the work. **Pedestrian Signal System, Accessible, Rem** also includes storage or disposal of removed material.

4. **Push Button Station, Rem**, includes removing a push button station, sign, associated assembly, brackets, hardware, fittings, cable, connectors, conduit(s), ground, and other material required to complete the work. **Push Button Station, Rem** also includes storage or disposal of removed material.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TRAFFIC SIGNAL BACKPLATE

SIG:EMS 1 of 2 APPR:HLO:NJB:05-01-20
FHWA:APPR:05-06-20

a. Description. This work consists of completing one or more of the following work types at location(s) shown on the plans:

1. Furnishing and installing a traffic signal backplate.

2. Removing and disposing of an existing traffic signal backplate.

3. Removing, storing and reinstalling an existing traffic signal backplate.

As applicable, this work includes removal or installation of hardware, connectors, fittings and all material necessary to complete the work.

b. Materials. Material must meet sections 819, 820, and 921 of the Standard Specifications for Construction.

1. Provide a one-piece backplate for three or four section traffic signal heads as indicated on the plans or as directed by the Engineer. Ensure that five section (doghouse) signal head combinations are provided with no more than three vacuum formed pieces.

2. Provide backplates that are designed to precisely fit the manufacturer's signal heads and supplied with necessary hardware to attach the backplate to the signal.

3. Provide backplates that are vacuum formed from 0.125 inch thick black acrylonitrile butadiene styrene (ABS) plastic with a hair cell finish on the front side (facing approaching traffic) to reduce glare.

4. Provide backplates that are constructed with a minimum 5/8 inch flange on all sides to provide structural rigidity. Ensure the backplates are provided with a three inch corner radius.

5. Ensure that all backplates extend approximately five inches around the perimeter of the traffic signal combinations after installation.

6. Provide backplates with an *ASTM Type IV* reflective yellow tape border. Ensure that a one inch border is used with yellow signal heads and visors, and a two inch border is used with black signal heads and visors.

7. Warranty. Provide materials with a manufacturer's warranty/guarantee, transferable to MDOT, that the supplied materials will be free from all defects in materials and workmanship for the stated time period from the date of shipment. Supply the Engineer with any warranty or guarantee documents from the manufacturer and a copy of the invoice showing date of

shipment.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specification for Construction, as shown on the plans, and as directed by the Engineer. Remove, store, and dispose of material in accordance with section 204 of the Standard Specification for Construction.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Backplate, TS	Each
Backplate, TS, Rem	Each
Backplate, TS, Salv	Each

1. **Backplate, TS** includes installing the backplate on existing or new signal head(s) at location(s) shown on the plans where installation is specified. Furnish and install a traffic signal backplate, as indicated on the plans or as directed by the Engineer.

2. **Backplate, TS, Rem** includes removing the existing backplate, hardware, and other appurtenances, required for a complete removal where removal is specified. Dispose of removed materials.

3. **Backplate, TS, Salv** includes removing the existing backplate, hardware, and other appurtenances required for a complete removal, storing salvaged materials in a clean environment, and reinstalling the materials where salvage is specified. Complete reinstallation in accordance with subsection c. of this special provision.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TRAFFIC SIGNAL WORK - CONSTRUCTION METHODS

SIG:EMS 1 of 2 APPR:HLO:NJB:04-29-20
FHWA:APPR:05-06-20

a. Description. This special provision is for electrical construction and/or relocation of traffic signal facilities is to be used in addition to the applicable sections of the standard specifications. In case of conflict use whichever is most restrictive.

b. Materials. Furnish new material and equipment, unless specified otherwise, and comply with sections 918 and 921 of the Standard Specifications for Construction. Materials furnished by the Department to the Contractor will be picked up by the Contractor at such site as designated by either MDOT, or the Local Agency representing MDOT, with any associated costs included in pay items as indicated on the plans and will not be paid for separately.

1. General. Provide manufacturer's certifications, in accordance with the specifications, for all wire and cable and other items or as directed by the Engineer. Do not install any wire or cable before it has been approved by the Engineer. Include statement "Materials are in accordance with the Specifications" on their material order, especially on wire and cable.

Reuse only the best of the existing material and equipment where the contract calls for reuse of existing material and equipment as directed by the Engineer. The Department will have the right to furnish the Contractor with a new part if any are found defective prior to dismantling. Any part or parts damaged by the Contractor subsequent to starting the removal are a liability of the Contractor.

Furnish the Engineer an as-built record of all underground or overhead work installed within 5 days after completion of each section of the underground conduit, cable or overhead line work. This record must include the size and length of cable and duct lines, location of the lines, handholes and manholes, and location and size of support poles. Tag and stamp all wires and cables using a brass tag indicating the source and use of the cable.

Connect the ground wire to the ground rod with a UL rated copper or bronze ground clamp.

c. Construction. All work must comply with sections 819 and 820 of the Standard Specifications for Construction, the applicable "typical" signal construction details, this special provision, and requirements of the *NEC*, *National Electrical Safety Code (NESC)*, and the Michigan Department of Licensing and Regulatory Affairs (LARA). Contact the LARA for electric service inspection and be responsible for payment of all applicable fees.

1. Maintain all existing street lighting, traffic signal, primary, transmission, communication cables, etc. circuits in an operational condition, unless otherwise noted on the plans or as directed by the Engineer.

2. In addition to subsections 104.07 and 812.03 of the Standard Specifications for

Construction, the following applies to Contractor maintenance of permanent or temporary traffic signal installations which are being worked on by the Contractor:

A. The Contractor is responsible for maintaining any portion of a traffic signal which has been worked on by the Contractor until final acceptance of that specific location.

B. If MDOT forces are required to work on an emergency traffic signal malfunction that is determined to have been caused by the work of a Contractor, the cost of the work will be the responsibility of the Contractor.

C. If vandalism occurs to equipment that is not energized, the Contractor is responsible for replacement.

3. Utility Coordination. Notify the System Operating Division of the local utility 72 hours in advance of any work on underground or overhead transmission or distribution circuits. If possible, the System Operating Division will shutdown and red tag the line by 8 a.m. for the day requested. Notify the System Operating Division when the work is complete.

Provide coordination and make arrangements, as described above, to work on traffic signal circuits.

Schedule, coordinate, install, and pay for work provided by the local utility company(s), as indicated on the plans or as directed by the Engineer. The Engineer will not authorize payment for delay caused by the Contractor's failure to properly schedule and coordinate any utility work.

4. Agency Coordination. Secure all necessary permits covering the operations, including permits from the Public Authorities having jurisdiction over the streets, or other Public Properties in which the work is located, and the improvements therein. Obtain the amount of any charges for payment, including fees or inspection charges required by such authorities, and include the cost of these fees in the bid prices.

The local traffic authority may impose restrictions regarding particular times of certain days of the week wherein the Contractor cannot perform work and may, in fact, be required to clear the area of work obstacles or construction equipment. The Contractor must take note of this and there will be no extra payment to perform the work with possible restrictions imposed. The Engineer will not authorize extra payment if the Contractor chooses to perform work during overtime status.

5. Ensure construction is performed by persons who are experienced and qualified for the work required. On-site licensed (Journeyman electrician) supervision is required for the electrical system installation (including placement of traffic loops, conduits, and/or cables in dirt, foundations, and handholes) and must be present at all times when electrical construction is in progress. Ensure the ratio of electrical journeymen or master electricians to registered apprentice electricians is on the basis of one electrical journeyman or master electrician to one registered apprentice electrician in accordance with Michigan Law section 338.883e. This ratio is to be enforced on a jobsite basis. For traffic signal work a single jobsite is defined as a single intersection or single electronic traffic control device.

MICHIGAN-
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TRAFFIC SIGNAL MAST ARM POLE AND MAST ARM

SIG:EMS 1 of 3 APPR:RWS:MJF:06-07-21
FHWA:APPR:06-07-21

a. Description. This work consists of furnishing, fabricating, and erecting a traffic signal mast arm pole and mast arm as shown on the plans, in accordance with the standard specifications, and as specified herein. This special provision is for an anchor base type steel mast arm pole, including mast arms, and other associated hardware required to complete the work.

b. Material. Provide material in accordance with sections 906 and 908 of the Standard Specifications for Construction and this special provision.

Material specifications for the traffic signal mast arm pole and mast arm are included in Table 1.

Table1: Material and Coating Specifications

Component	Specifications
Pole Tube	*ASTM A595/A595M GR A or ASTM A572/A572M GR 50*
Mast Arm Tube	*ASTM A595/A595M GR A or ASTM A572/A572M GR 50*
Mast Arm Clamp	*ASTM A36/A36M*
Gusset Plate	*ASTM A36/A36M*
Hand Hole Frame	*ASTM A705/A705M GR 50* or *ASTM A572/A572M GR 50*
Lifting Pipe	*ASTM A53/A53M GR B or ASTM A501/A501M*
Handhole Cover	*ASTM A1011/A1011M GR 36*
Pole Top	*ASTM B26/B26M (356F or 43)*
Stainless Steel Hardware	*AISI 300 SERIES (18-8)*
Luminaire Arm High Strength Bolts	*ASTM F3125/F3125M GR A325*
Mast Arm Studs	*ASTM A449*
“ANCO” Lock Nuts or Equivalent	*ASTM A563 GR DH*
Flat Washers	*ASTM F436/F436M*
Lock Washers	*ANSI B18.21.1*
Steel Plate and Shape Finish	*ASTM A123/A123M*
Hardware Finish	*ASTM A153/A153M*
Telescopic Field Splice Bolt	*ASTM A307*
C-Hook	*ASTM A36/A36M*
J-Hook	*ASTM A36/A36M*

Use high strength bolts, nuts, and washers in accordance with subsection 906.07 of the Standard Specifications for Construction.

Structural steel material used to fabricate the traffic signal mast arm pole and mast arm is required to be accepted based on “Fabrication Inspection” per the *Materials Quality Assurance Procedures (MQAP)* manual.

c. Fabrication. Fabricate and weld in accordance with section 707 of the Standard Specifications for Construction and the *American Welding Society (AWS) D1.1*, *Structural Welding Code – Steel* (as modified by 20SP-707A - Structural Steel and Aluminum Construction), hereafter called *AWS D1.1*, except as modified herein). Fabricator must possess an active *American Institute of Steel Construction (AISC)* - Bridge Component QMS Certification (CPT) and Sophisticated Paint Endorsement (SPE) if painting steel surface areas greater than 500 square feet. The Engineer will accept *Society of Protective Coatings (SSPC) QP3* - Standard Procedure for Evaluating the Qualifications of Shop Application Firms.

1. The pole and arm tubes must have a uniform taper.

2. Tolerance for overall length of pole tube and arm tube(s) is ±1/8 inch. Tolerance for sweep and camber of pole tube and arm tube(s) is 1/8 inch per 10 foot. Tolerance for twist of pole tube and arm tube(s) is ±10 degrees.

3. The pole tube and arm tube cannot have more than one longitudinal seam weld. Roll or grind flush the longitudinal seam weld. Transverse welds in the pole and arm tubes are prohibited.

4. Attach the arm tube to a connection plate by a full penetration weld. Bolt the arm tube to the pole tube as shown on the plans. Control distortion of flange plates for flatness to assure full contact between mating surfaces in an unbolted, relaxed condition.

5. Weld the longitudinal arm seam on the male and female sections of the telescopic (i.e. slip-type) field splice with a complete joint penetration (CJP) weld a minimum of 36 inches long. When the field splice is erected and in its final position the lap of the arm sections cannot extend beyond the longitudinal arm seam CJP weld.

6. All welds must be 100 percent visual test (VT) inspected by an *AWS* Certified Welding Inspector (CWI).

7. All fillet welds must be 25 percent magnetic particle test (MT) inspected by a technician qualified in accordance with *American Society for Nondestructive Testing (ASNT)* Level II. Perform MT in accordance with *ASTM E709* with dry powder using the yoke method.

8. All partial joint penetration (PJP) longitudinal seam welds must be 10 percent MT inspected by a technician qualified in accordance with *ASNT* Level II. Perform MT in accordance with *ASTM E709* with dry powder using the yoke method.

9. All complete joint penetration (CJP) welds must be 100 percent ultrasonic test (UT) inspected by a technician qualified in accordance with ASNT Level II per subsection 918.10 of the Standard Specifications for Construction, except the acceptance/rejection criteria for material thickness equal to or greater than 5/16 inch will be in accordance with the cyclicallys loaded nontubular connections in tension criteria stated in *AWS Clause 6*.

10. Evenly space the pole base plate holes so the pole may be bolted to a concrete foundation as shown on the plans. Finish the lower surface of the base plate flat and at 90

degrees to the pole axis.

11. Provide a hand hole opening and cover. Weld a reinforcing frame to the pole for the handhole opening. Ensure the placement of the handhole does not reduce the strength of the pole. Securely fasten the handhole cover using stainless steel hex head cap screws or by an approved locking device.

12. Provide a suitable pole top with means for securing it to the top of the pole.

13. Provide a hook or other suitable device for the support of cable on the inside of the pole near the top.

14. Weld square stock that has been drilled and tapped to the inside of the hand hole so that it is readily accessible from the hand hole for grounding purposes.

15. Fabricate the arm to pole upright connection to compensate for mast arm deflection. Show this detail on shop drawings for approval by the Engineer.

d. Erection. Tighten anchor bolts in accordance with subsections 810.03.N.2 and 810.03.N.3 of the Standard Specifications for Construction.

Tighten pole cap, mast arm cap, and luminaire arm high strength bolts to a snug tight condition in accordance with 707.03.E.6.c of the Standard Specifications for Construction.

Ensure all installation procedures are witnessed by the Engineer.

e. Construction. Ensure all work complies with sections 819, 820, and subsection 810.03 of the Standard Specifications for Construction, the applicable signal construction plan sheets, and this special provision.

For repair coating, apply a coating 1½ times the thickness or thickness equivalent specified for galvanizing on the item, but not less than 5 mils. Use zinc-based solder, zinc-rich primer, or zinc metallizing in accordance with *ASTM A780/A780M*. Obtain the Engineer's approval before using zinc metalizing.

f. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Mast Arm Pole, Cat __	Each
Mast Arm, __ foot, Cat __	Each

Mast Arm Pole, Cat __ and **Mast Arm, __ foot, Cat __** includes furnishing all materials, fabrication, shop cleaning, galvanizing, shipping, and erection.

No extension of time or additional compensation will be granted due to obtaining the proper *AISC* certifications and/or endorsements required for this project.

Construction of the foundation will be included in other items.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TRAFFIC SIGNAL WIRELESS COMMUNICATIONS LINK

SIG:EMS 1 of 6 APPR:NJB:HLO:03-27-23
FHWA:APPR:03-28-23

a. Description. This work consists of completing one or more of the following work types at locations shown on the plans:

1. Performing site evaluation and furnishing, installing, integrating, and testing a wireless communications link at locations designated on the plans. Wireless communications links will consist of all cabling, radios, antennas, and the system appurtenances required to complete a functional link. Perform this work in accordance with the standard specifications, except as modified herein.

2. Removing and disposing of an existing wireless communications link.

3. Removing, storing, and reinstalling an existing wireless communications link.

b. Materials.

1. Traffic signal wireless communications link. Furnish a traffic signal wireless communications link from the following list.

A. Encom Broadband Radio

B. Approved equal (AE). Ensure the AE is evaluated, tested, and approved per the MDOT New Traffic Signal Device Product Review Guidelines. The review time is not justification to delay the project.

2. Furnish wireless link equipment including a transmitter, receiver, antenna, cabling, patch cords and jumpers, surge suppressors and lightning protection, attenuators, splitters, amplifiers, and power supply.

A. Ensure installed field equipment can operate in all weather conditions, as applicable within Michigan.

B. Use interoperable and interchangeable equipment at each field location.

C. Supply all equipment required for the configuration and testing of devices and sub-systems contained in this project as an appurtenance to the equipment included in the project and at no additional cost to the contract.

3. Minimum technical requirements for Wireless Link radios.

A. Technology Solutions. Line of Sight (LOS) wireless technologies, n/NLOS wireless technologies where wireless paths are obstructed - orthogonal frequency division

multiplexing (OFDM), multiple-input multiple-output (MIMO) or other compatible n/NLOS wireless technologies.

B. Security Configurations. Authentication, IP Address/Media Access Control (MAC) Address Filtering.

C. Network Connection Types. 10/100Base-TX; 1000Base-T where Gigabit Ethernet is required as shown on the plans.

D. Intelligent packet filtering by network address, protocol, or packet content.

E. Simple network management protocol (SNMP) compliance. Management information base (MIB)-I, MIB-II.

F. IEEE Standards: 802.3 Ethernet, 802.1p Bridging Mode, 802.1Q Virtual Local Area Network (VLAN).

G. Remote Configuration. Wired or wireless local area network (LAN) station telnet, file transfer protocol (FTP), or hypertext markup language (HTML) via web browser.

H. Packet Routing. Store and forward capability required where error checking and error correction features and functions are not an option of the submitted equipment.

I. Error Checking. Cycle redundancy check (CRC) 32 Bit and package protocol acknowledgment.

J. Error Correction. Forward error correction (FEC), automatic repeat request (ARQ).

K. Network Topology. Point-to-point (PTP) and Point-to-multi-point (PTMP) configurations are required as shown on the plans.

L. Configuration and Network Management. Ensure the radio system is furnished with a network visualization and management software that allows for configuration and diagnostics of the entire wireless network. The software package must allow the operator to communicate with all similar radios in the system including 900 megahertz (MHz), 2.4 Gigahertz (GHz), 4.9Ghz and 5.8GHz Ethernet radios and serial data radios. Ensure the following features are present within the software:

(1) Complete configuration tool:

(a) Includes comprehensive context-sensitive online help;

(b) Profile based configuration with the most common configuration supplied with the software;

(c) Configuration assistance tools to detect any error on the fly;

(d) Profile import/export tools allow user to easily copy configuration from radio to radio;

(e) Supports configuration of quality of service (QoS), VLAN, firewall and port forwarding;

(f) Automatically displays comprehensive radio configuration and status information when a radio is selected.

(2) Monitoring:

(a) Built-in mapping system uses freely available maps to help visualize the location of the radios and the topology of the radio network;

(b) Use only free open source mapping engine with no ongoing cost to end user;

(c) Mapping system has an off-line mode for use with a laptop without internet connection;

(d) A simple map icon indicates the radio location, online/offline status, signal level, wireless link rates and their performance, that are all updated in real time;

(e) Network Traffic Monitoring Tools.

(3) Diagnostics:

(a) High resolution software spectrum analyzer helps the user select the wireless channel that has the least interference;

(b) Antenna alignment tools with graphical signal level display and signal sensitive audio tone available;

(c) Antenna alignment tools support per connection and per-chain alignment (for wireless-N radios);

(d) Comprehensive bandwidth test tools to identify bottlenecks in the network;

(e) Ping test tools to verify the performance of the network.

(4) Alarm reporting:

(a) User configurable alarm settings such as:

(i) Online/offline status;

(ii) Receive signal level drops;

(iii) Connection quality drops; and

(iv) Data rate drops.

(b) Alarms are logged and optionally e-mailed to any number of recipients.

(5) Licensing:

(a) No software licensing registration or fees required;

(b) No ongoing map functionality costs;

(c) Can install on any number of laptops or workstations; and

(d) Ensure web browser interface is also available to configure the radios.

M. LED Indication. Ensure all radios include visual indication for power and signal strength.

N. Radio Options. Where shown on the plans the selected radio platform must include options for:

(1) A secondary Ethernet port that can be used as a power over Ethernet (POE) output;

(2) An audio port used for aligning the antenna;

(3) A reset to default button; and

(4) A dual radio option that contains two transmitters in one platform.

4. Functional Requirements.

A. Furnish radios capable of operating in Near-Line of Sight (nLOS) and Non-Line of Sight (NLOS) environments where wireless path obstructions are present. n/NLOS radios and antennas are to support OFDM, MIMO and/or other applications, features and technologies that are suitable for n/NLOS radios and antennas.

B. Furnish 2.4GHz, 4.9GHz or 5GHz radios with a minimum data rate of 54 Megabits per second (Mbps) and capable of transmitting and receiving at distances shown on the plans.

C. Furnish radios capable of being asymmetrically adjusted to enhance bandwidth. Furnish wireless link software that enables configuration up and downstream link splits to accommodate bandwidth needs.

D. Furnish a minimum link availability of 99.9 percent over the specified distance.

E. Furnish a password protected network management software (NMS) or configure the radio's web browser interface allowing for the remote configuration of the wireless link and the ability for remote software/firmware updates.

F. Furnish radios capable of using the required number of non-overlapping channels to communicate with all radios communicating with it.

G. Furnish radios with dynamic and manual selection of available channels. The capability of locking in radio channels manually (in either direction) and restricting each segment to specified channels is required.

H. Mutual security authentication and support for data encryption system (DES) or advanced encryption system (AES) encryption and authentication via remote

authentication dial-in user service (RADIUS) is required for the wireless link.

I. Ensure the wireless link is fully interoperable with any existing signal communications network.

J. Ensure each unit is software configurable to work as a master, remote, mesh node, hotspot or repeater. It is not acceptable to have different units for each mode of operation.

K. Ensure all mounting hardware for the radios and antennas, including Category 5e or better industrial outdoor rated cable is included as shown on the plans.

L. Ensure the radios specified are capable of over the air firmware upgrades.

c. Construction. Complete this work in accordance with sections 818 and 820 of the Standard Specifications for Construction, as shown on the plans and as directed by the Engineer.

1. Installation.

A. Furnish the Engineer 10 days advanced notice of planned date of installation for the wireless links. Obtain the Engineer's approval prior to beginning antenna installation. Coordinate installation with MDOT electrician. Install the radio antennas after the rest of the signal equipment (signal heads, poles, case signs, span wire, etc.) has been installed.

B. Adjust mounting and orientation of antennas as required during the testing process performed by the MDOT electrician. Reorient or move radio antenna installations that were completed prior to the approval of the Engineer, and which are found to be non-optimal placement of the antennas at no additional cost to the contract. The Engineer will not authorize extra payment or time extensions for work required to reorient or move the radio antenna.

C. Wiring Requirements. Cut all wires to proper length before assembly with no wire doubled-back to take up slack. Furnish cabling laced with nylon and plastic straps and secured with clamps. Furnish service loops at all connection points.

D. Local Device Assembly Test (LDAT).

(1) Verify physical construction has been completed per the contract.

(2) Inspect the quality and tightness of ground connections.

(3) Verify the radio has been configured with the proper site name, IP address, subnet mask, gateway, and VLAN settings.

(4) Verify actual throughput meets requirements using two laptops with Iperf, Jperf, or similar approved software. Verify wireless links maintained a minimum actual measured data throughput of 10 Mbps for 10 minutes duration.

(5) Record the throughput, signal-to-noise ratio (SNR), received signal strength (RSS), and noise level.

E. Furnish and install the wireless link, IP, master or remote as shown on the plans.

2. Documentation Required.

A. Furnish complete and detailed cut-sheets on all equipment.

(1) Include equipment/parts list, schematic diagrams, antenna selection, radio equipment, communication equipment and cabling, equipment rack layouts, and device connection/protocol information.

(2) Present a list of tools and test equipment (common and specialized, and including any built-in testing facilities that are functionally equivalent to external test equipment) necessary to install, operate, test, and maintain all equipment proposed in this project.

B. Furnish any exportable electronic configuration files for each Wireless Link, Master and Remote. The file will contain the location of the wireless link, its serial number, and final accepted configuration, and will be named to clearly indicate the device location from which it was obtained.

C. Warranty. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final written acceptance. Furnish the wireless link with a standard manufacturer's warranty, transferable to MDOT. The wireless link must carry a warranty (parts, software and labor) of 1 year from the date of shipment.

3. Maintain all equipment through final acceptance, including, but not limited to, furnishing and installing all available software/firmware upgrades.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
TS, Wireless Link, (frequency), (type)	Each
TS, Wireless Link, Rem	Each
TS, Wireless Link, Salv	Each

1. **TS, Wireless Link, (frequency), Master** includes evaluating, procuring, constructing, and verify testing of a master radio.

2. **TS, Wireless Link, (frequency), Remote** includes evaluating, procuring, constructing, and verify testing of a remote radio.

3. **TS, Wireless Link, Rem** includes removing and storing or disposing of an existing traffic signal wireless link at the location(s) shown on the plans.

4. **TS, Wireless Link, Salv** includes reinstalling a removed traffic signal wireless link at the location(s) shown on the plans.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
PEDESTAL, UNDERGROUND SERVICE, METERED AND UNMETERED

SIG:EMS 1 of 2 APPR:BA:HLO:05-05-20
FHWA:APPR:05-06-20

a. Description. This work consists of installing or removing a complete pedestal for underground (UG) electrical service, either metered and/or unmetered. A complete pedestal UG electrical service includes the pedestal, meter socket (as required), brackets, hardware, fittings, connectors, cable, conduit, risers, grounding, and all appurtenant material required to complete the work.

b. Materials. Provide pedestal(s) in accordance with this special provision. Provide hardware, connectors, cable, conduit, and all other appurtenant materials in accordance with sections 918 and 921 of the Standard Specifications for Construction. Provide other required material, not specifically addressed in the Standard Specifications for Construction, in accordance with local utility company requirements and the *NEC*. Ensure the UG electrical service pedestal is in accordance with the following:

1. Suitable for mounting on a foundation as shown on the plans;

2. Fabricated from stainless steel;

3. Equipped with a 3- to 6-circuit, load center, 100 ampere service rated;

4. Neutral and ground lugs installed 15 inches from grade;

5. Customer door to have gasket on all four sides and equipped with a main door lock, Corbin no. 15481RS, Pelco (Type II) SM-1025 or equivalent Lock to be constructed of nonferrous or stainless materials, which operates with a Traffic Industry conventional #2 key, Corbin No. 1R6380 or Pelco (Type II) SM-0198-2 or equivalent. Ensure a minimum of two keys are included for the main door of each cabinet.

6. Ensure unmetered pedestal are no greater than: Width = 12.00 inches, Depth = 8.25 inches, Height = 32.00 inches; and

7. Ensure metered pedestal are no greater than: Width = 12.00 inches, Depth = 8.25 inches, Height = 52.00 inches.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, per the contract, and this special provision.

Contact the local power company and coordinate installation or removal, of underground electrical service power feed and meter and meter sockets as required, as indicated on the plans or as directed by the Engineer.

Where installation of new underground service, metered, is called for on the plans, install a new meter socket and provide bonding in compliance with MDOT, *NEC*, *National Electrical Safety Code (NESC)* and local utility company requirements. Use weatherproof LB's to enter and exit all meters, service disconnects, and controllers. Complete additional work required by the local utility company to make a complete and operating installation.

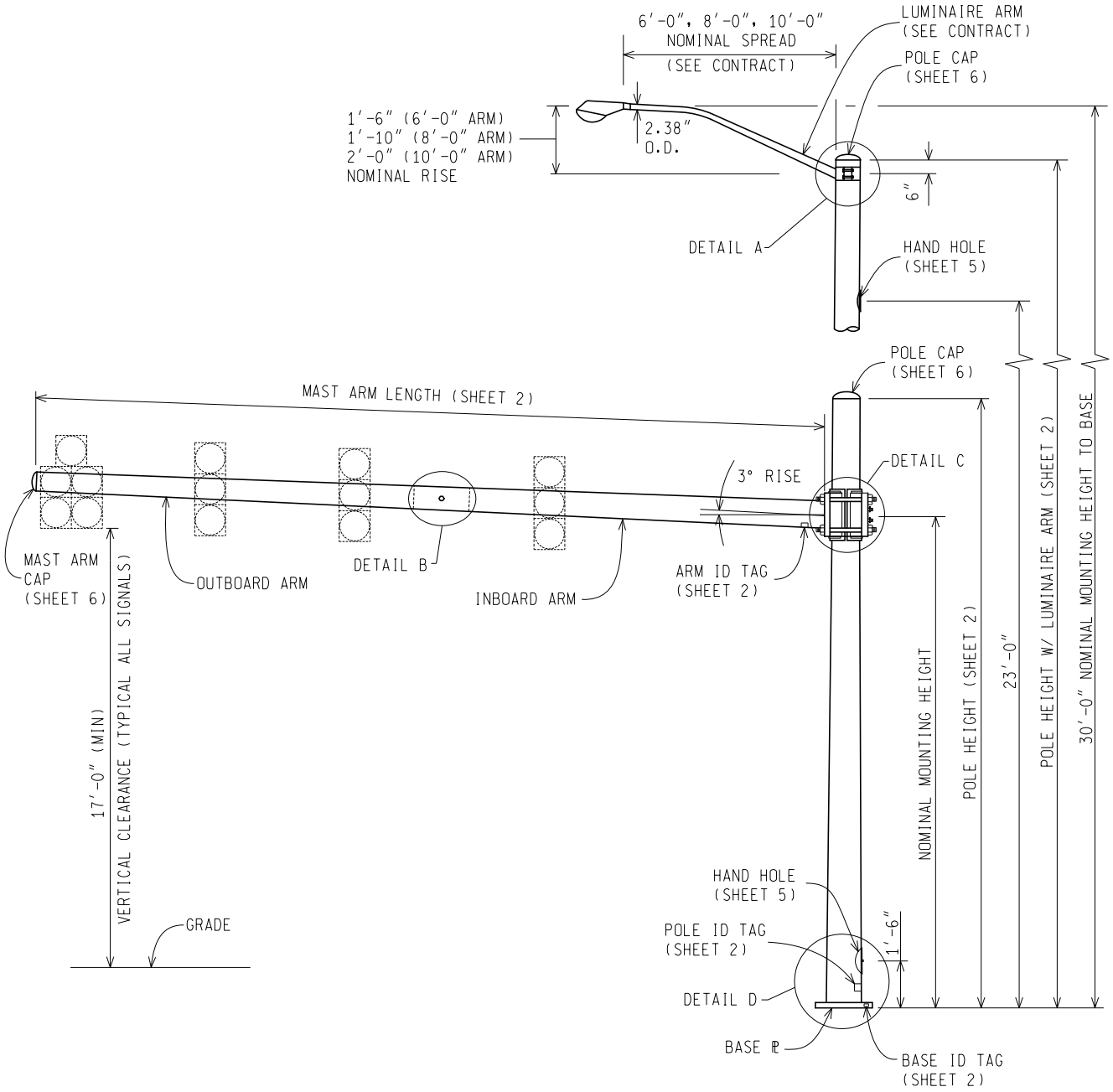
Where removal is called for on the plans, complete removal work in accordance with MDOT, *NEC*, *NESC,* and local utility company requirements.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Pedestal, Underground Serv, (type)	Each
Pedestal, Underground Serv, Rem	Each

1. **Pedestal, Underground Serv, (type)** includes the work as described, including additional work required by the local utility company to make a complete and operating installation.

2. **Pedestal, Underground Serv, Rem** includes the work as described, including additional work required by the local utility company to remove a complete pedestal for underground electrical service.



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MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

TRAFFIC SIGNAL MAST ARM POLE AND MAST ARM DETAILS - CATEGORY II

PLAN DATE

SIG-031-B

SHEET
1 of 6

ROUND TAPERED STEEL MAST ARM			
MAST ARM LENGTH	* MAST ARM DIMENSIONS	MTG HT SINGLE	MTG HT TWIN
20'-0"	0.2500"-8.50" x 5.70" x 20'-0"	19'-0"	18'-6" & 21'-0"
25'-0"	0.2500"-9.50" x 6.00" x 25'-0"		
30'-0"	0.2500"-10.50" x 6.30" x 30'-0"		
35'-0"	0.4290"-12.00" x 10.60" x 10'-0" 0.1793"- ** x 7.50" x **		
40'-0"	0.5000"-12.00" x 10.60" x 10'-0" 0.1793"- ** x 6.80" x **		
45'-0"	0.5000"-12.00" x 9.90" x 15'-0" 0.1793"- ** x 6.10" x **		
50'-0"	0.7500"-12.0" x 9.20" x 20'-0" 0.1793"- ** x 5.36" x **		

MAST ARM TUBE TAPER IS 0.140 IN/FT

* DIAMETERS GIVEN ARE O.D.

** TO BE DETERMINED BY CONTRACTOR BASED ON REQUIRED MAST ARM LENGTH AND TELESCOPIC SPLICE LENGTH.

ROUND TAPERED STEEL MAST ARM POLE		
* POLE DIMENSIONS	LUMINAIRE ARM	MAST ARM LENGTH (FT)
0.313"-14.00" x 10.92" x 22'-0"	NO	20, 25
0.313"-14.00" x 9.94" x 29'-0"	YES	30, 35
0.358"-14.00" x 10.92" x 22'-0"	NO	40, 45
0.358"-14.00" x 9.94" x 29'-0"	YES	
0.478"-14.00" x 10.92" x 22'-0"	NO	50
0.478"-14.00" x 9.94" x 29'-0"	YES	

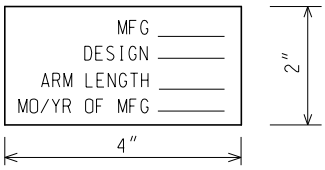
POLE TUBE TAPER IS 0.140 IN/FT

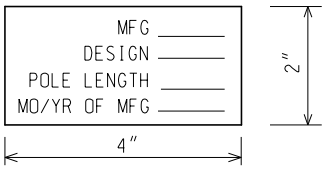
* DIAMETERS GIVEN ARE O.D.

NOTE: ONLY USE THE MAST ARM LENGTHS WITH POLE SIZES AS INDICATED IN TABLE ABOVE

NOTES:

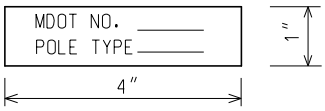
1. THE DESIGN OF THIS STRUCTURE IS BASED ON THE 2001 AASHTO STANDARD SPECIFICATONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS FOR 90 MPH WIND LOAD AND CATEGORY II WITH GALLOPING, NATURAL WIND GUSTS, AND TRUCK INDUCED FATIGUE LOADS.
2. WELD THE LONGITUDINAL ARM SEAM ON THE INBOARD AND OUTBOARD SECTIONS OF THE TELESCOPIC FIELD SPLICE WITH A COMPLETE JOINT PENETRATION (CJP) WELD A MINIMUM OF 36 INCHES LONG. IN ADDITION, LONGITUDINAL SEAM WELDS MUST BE CJP FOR A MINIMUM OF 6 INCHES FROM TUBE TO PLATE CJP WELDS.
3. SEAM WELDS MUST BE 90° ± FROM HAND HOLE AT BASE.
4. LUMINAIRE ARM IS 11 GAUGE ROUND STEEL WITH 0.140 INCH PER FOOT TAPER.
5. BACKING BAR FOR PIPE TO BASE PLATE (℄) AND MAST ARM TO MAST ARM PLATE MUST BE MINIMUM 5/16 INCH X 2 INCH PLATE.
6. 1/2 INCH DIAMETER (Ø) ROUND STOCK C-HOOK ATTACHED TO ALL POLE SIZES. 3/4 INCH SCHEDULE (SCH.) 40 PIPE ATTACHED TO ALL POLE SIZES AND INBOARD AND OUTBOARD ARM.
7. S.S. DENOTES STAINLESS STEEL. GA. DENOTES GAUGE. O.D. DENOTES OUTSIDE DIAMETER. I.D. DENOTES INSIDE DIAMETER. H.S. DENOTES HIGH STRENGTH.





ARM/POLE S.S. ID TAG DETAIL

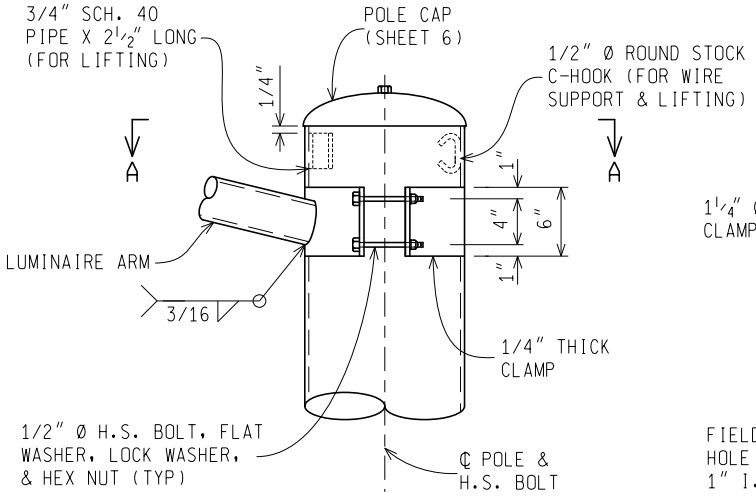
TO BE ATTACHED TO POLE OR MAST ARM AT LOCATIONS SHOWN 4" FROM BASE OF TUBE BELOW HANDHOLE WITH (4) #8 X 3/8" S.S. TYPE U DRIVE SCREWS.
(LETTERS STAMPED IN 3/8" CHARACTERS)



BASE S.S. ID TAG DETAIL

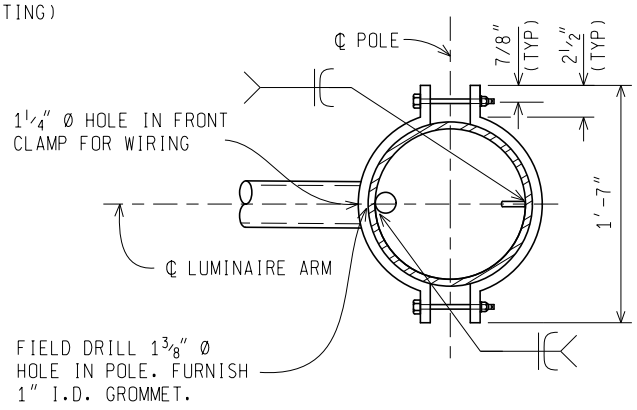
WELD TAG TO EDGE OF BASE ℄
(LETTERS STAMPED IN 3/8" CHARACTERS)

NOT TO SCALE

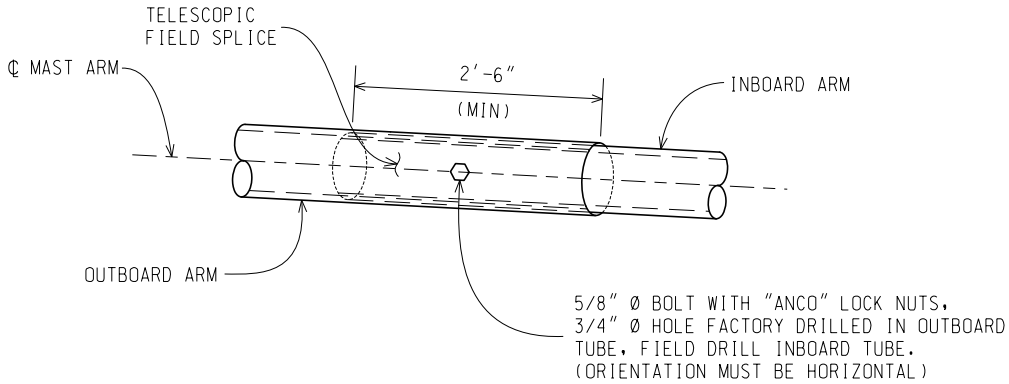


DETAIL A

ORIENTATION OF SCH. 40 PIPE 180° FROM HAND HOLE AT BASE & C-HOOK 180° FROM SCH. 40 PIPE

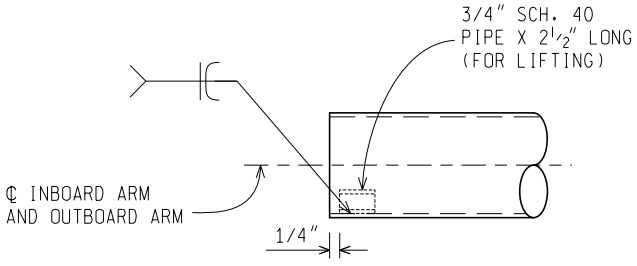


SECTION A-A



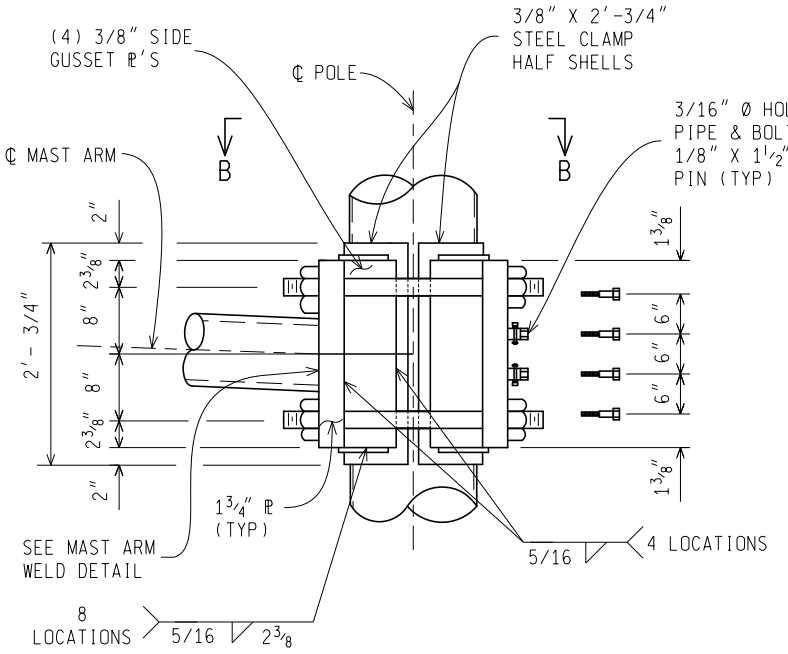
DETAIL B

(35'-0" ARMS AND GREATER)

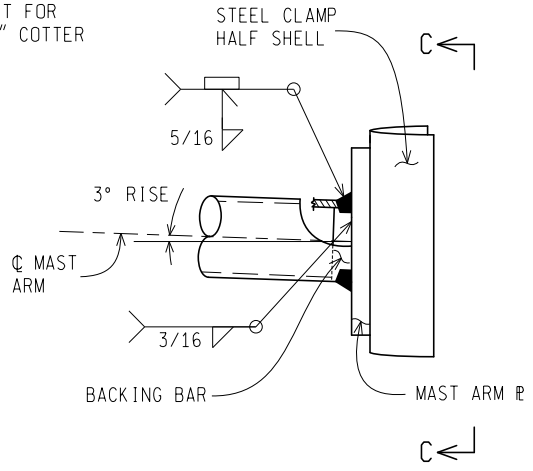


INBOARD/OUTBOARD ARM LIFTING DEVICE

NOT TO SCALE

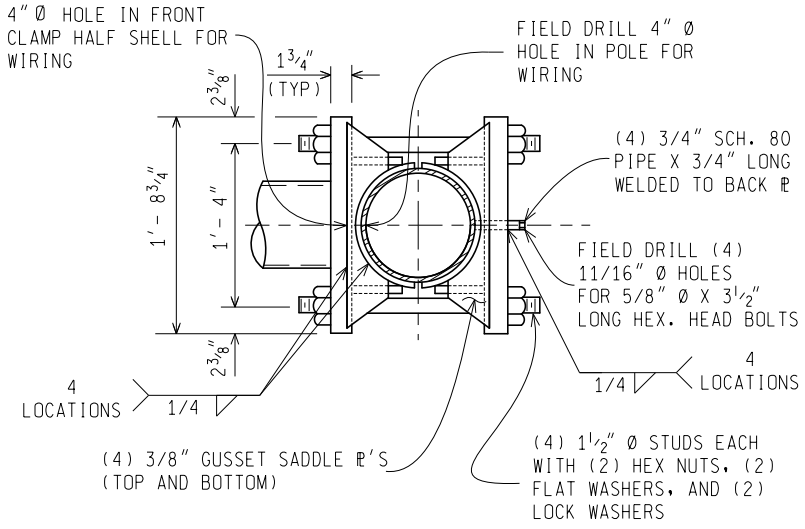


DETAIL C



MAST ARM WELD DETAIL

SIDE GUSSET PL'S AND SADDLE PL'S NOT SHOWN FOR CLARITY



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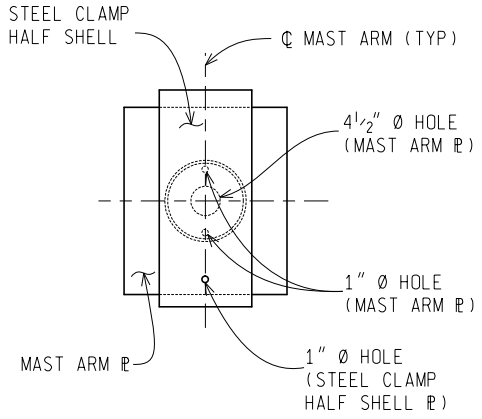
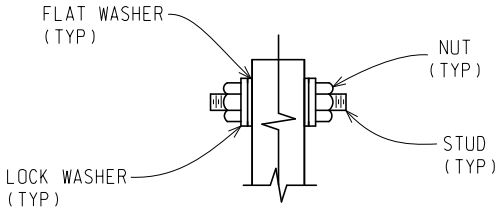


SECTION C-C

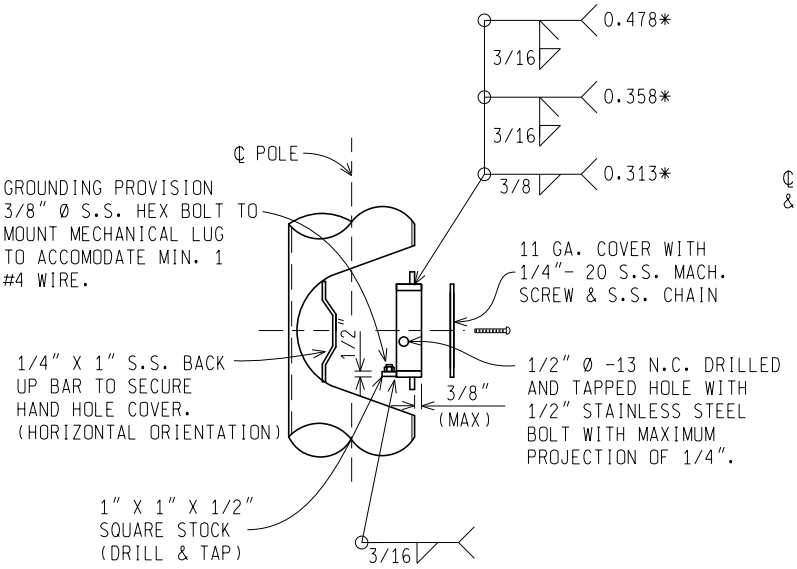
SIDE GUSSET PL'S AND SADDLE PL'S NOT SHOWN FOR CLARITY

NOT TO SCALE

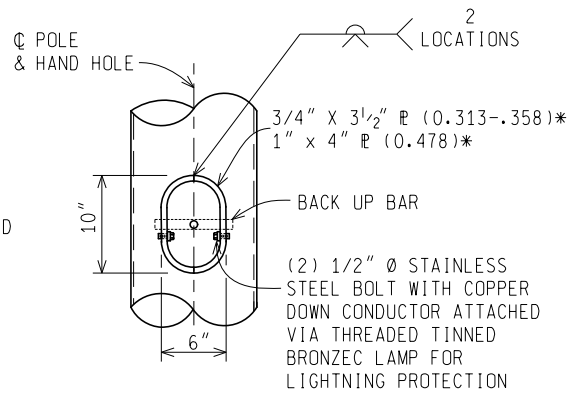
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	FHWA APPROVAL DATE		SIG-031-B	SHEET 4 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG031B.dgn Rev. 11/05/18		PLAN DATE		



MAST ARM CLAMP WASHER PLACEMENT

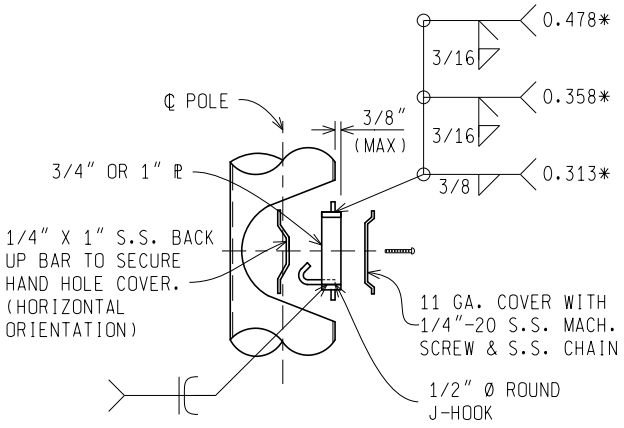


6" X 10" BAR BOTTOM HAND HOLE



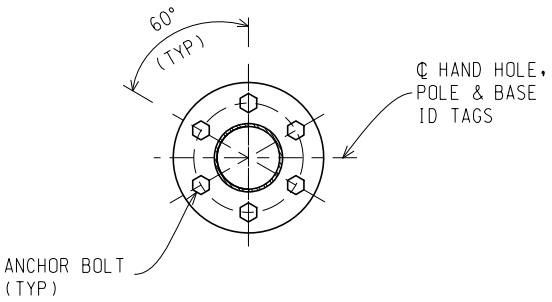
6" X 10" BAR BOTTOM HAND HOLE

(VIEW ROTATED 90 DEGREES)



4" X 6½" BAR TOP HAND HOLE

DESIGN WITH 29'-0" POLE ONLY

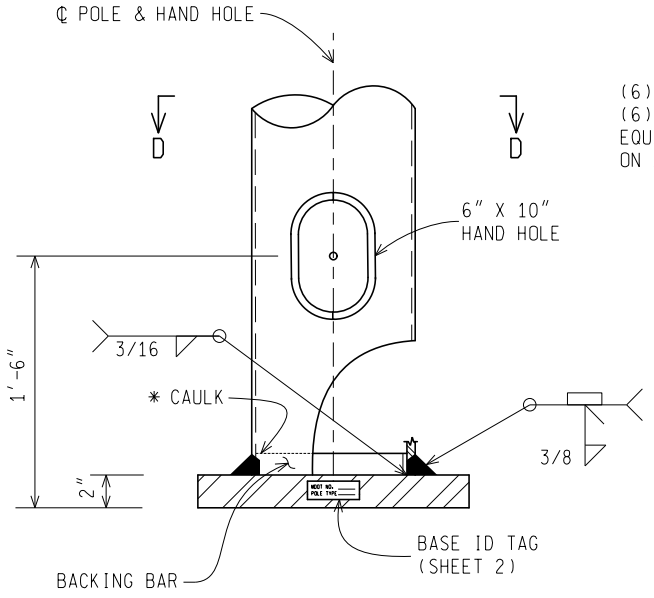


ORIENTATION OF HAND HOLE

* THICKNESS OF POLE

NOT TO SCALE

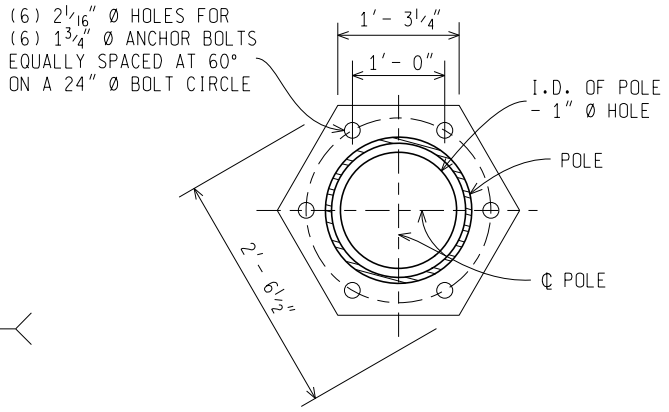
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	FHWA APPROVAL DATE		SIG-031-B	SHEET 5 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG031B.dgn Rev. 11/05/18		PLAN DATE		



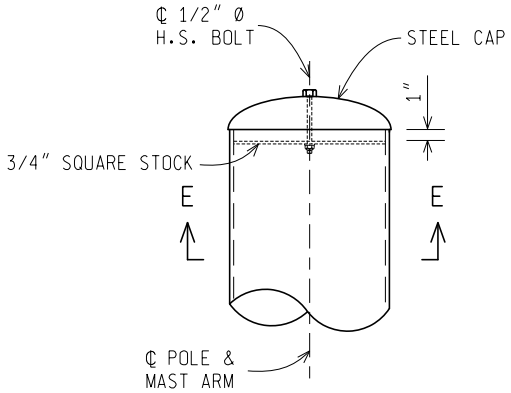
DETAIL D

(VIEW ROTATED 90 DEGREES)

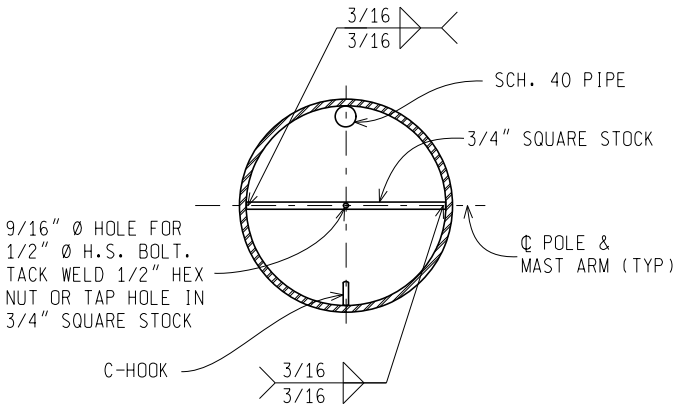
✱ SEAL JOINT WITH CAULK AFTER GALVANIZING



SECTION D-D



POLE AND MAST ARM CAP DETAIL



SECTION E-E

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	FHWA APPROVAL DATE		SIG-031-B	SHEET 6 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG031B.dgn Rev. 11/05/18		PLAN DATE		

NOTES:

1) All ground rods shall be 3/4"x10' copper clad rod a minimum of 2 ground rods shall be used (one for the service disconnect and one for the messenger cable & pole).

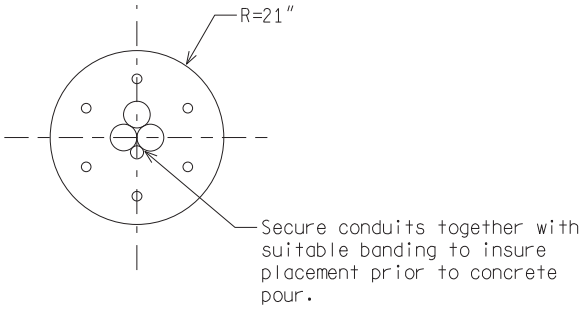
2) Ground rod placement shall not be less than 12" from the foundation with a minimum of 6' between ground rods. Placement shall be as directed by the Engineer and in compliance with N.E.C.

3) Ground wire connection to grounding rod(s) shall utilize a non-solder type connection.

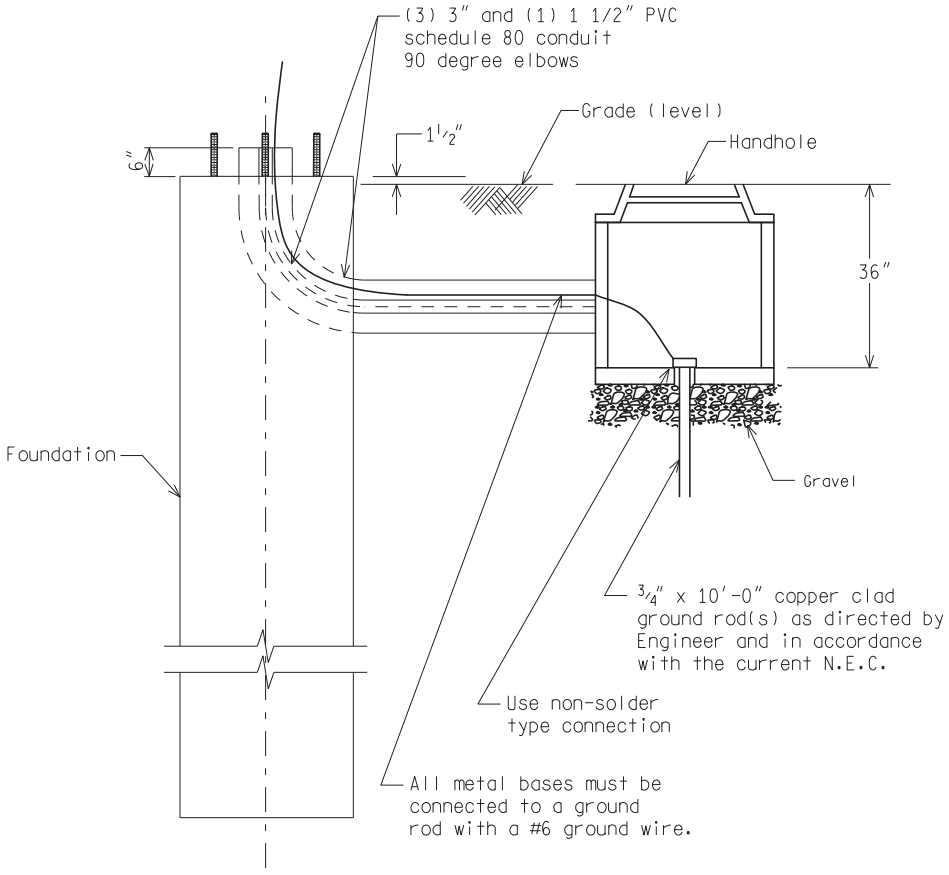
4) Indicate the direction of conduits in foundation top with an arrow.

5) Install pole that the foundation & anchor bolts are plumb.

6) All grounds shall provide less than 10 ohm resistance to ground.



PLAN



ELEVATION

MAST ARM FOUNDATION CONDUIT AND GROUNDING

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG040A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

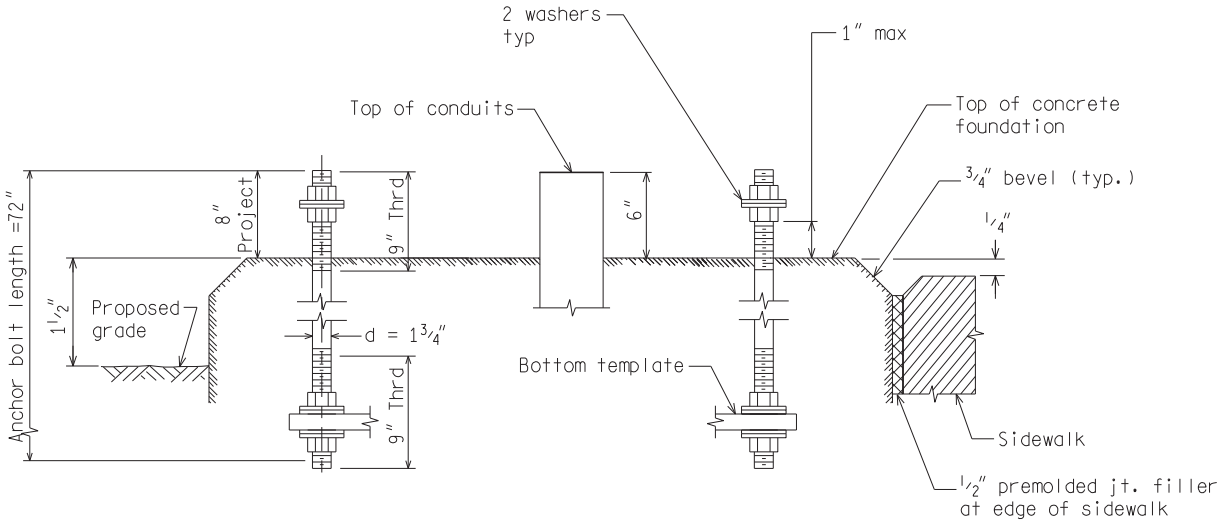
FHWA APPROVAL DATE

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

TRAFFIC SIGNAL MAST ARM STANDARD FOUNDATIONS

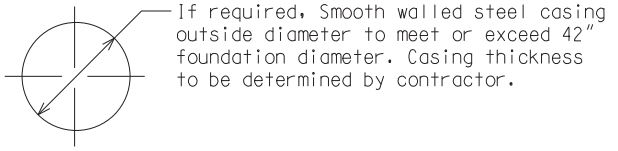
PLAN DATE

SIG-040-A



ANCHOR BOLTS

NOTE:
Trench for placement of conduits after casing is in place and before dewatering.



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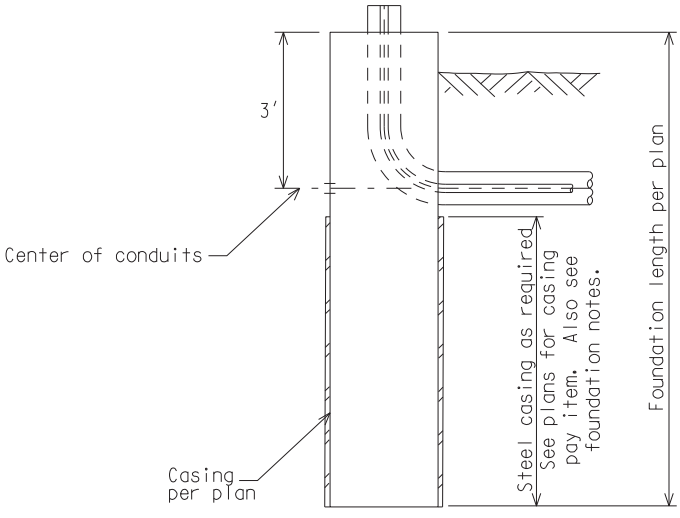


ELEVATION

DRILLED FOUNDATION SHAFT (SHOWN WITH CASING PAY ITEM)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG040A.dgn Rev. 02/16/17		PLAN DATE	SIG-040-A	SHEET 2 of 4

NOTES:

1. Anchor bolts shall be set and held vertical at the correct location and at the proper elevation with a 3/4" steel (or approved equal) template a minimum of 24 hours after the concrete placement has been completed.

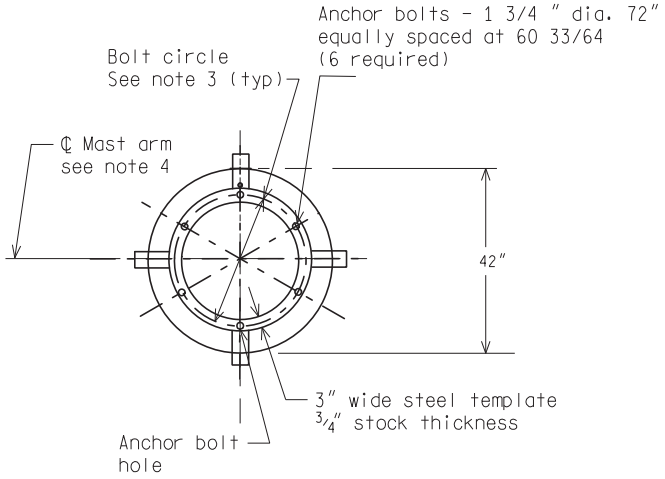
2. (6) 1 3/4" - 72" Anchor bolts with (4) Hex nuts and (4) washers per bolt.

3. 24" dia bolt circle for Category I, Category II, and Category III Mast Arms.

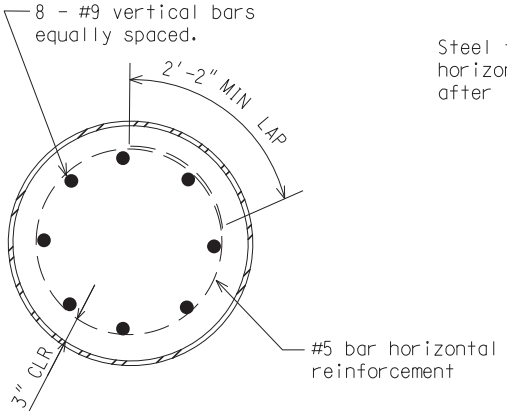
4. Mast arm orientation is not dependent on anchor bolt position.

5. Use #4 AWG or larger standard bare ground wire bonded by mechanical connection to foundation reinforcing steel and having 24" of slack above the top of foundation.

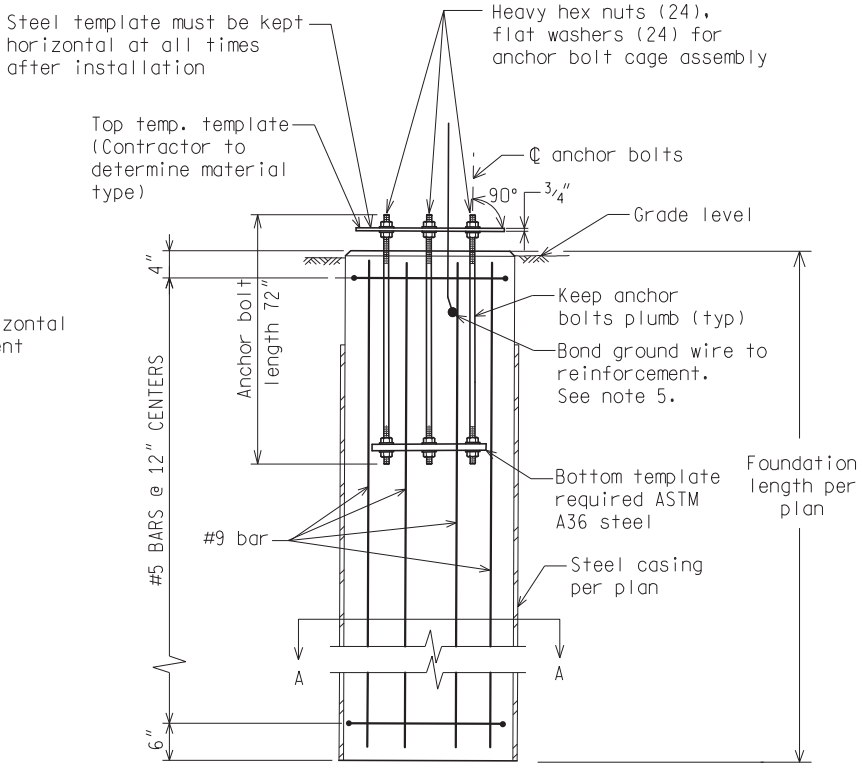
6. Galvanize all exposed nuts, bolts, and washers according to ASTM F2329. Galvanize all other steel items according to ASTM A123. Embedded nuts, bolts, washers, and steel ring need not be galvanized.



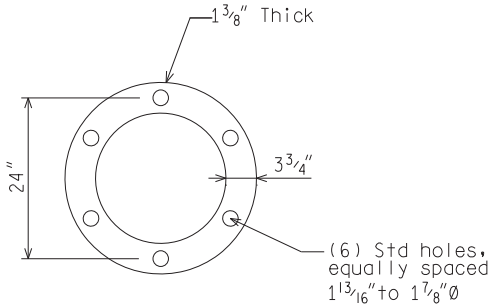
PLAN VIEW



SECTION A-A



ELEVATION



BOTTOM STEEL TEMPLATE

MAST ARM FOUNDATION (SHOWN WITH CASING PAY ITEM)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-040-A	SHEET 3 of 4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG040A.dgn Rev. 02/16/17		PLAN DATE		

Foundation Notes:

1. Refer to the following special provisions related to 6 anchor bolt mast arm poles:
   Traffic Signal Mast Arm Pole and Mast Arm
   Mast Arm Pole Foundation and Anchor Bolts
   Casing Used With Strain Poles and Mast Arm Poles

2. Templates shall be shop fabricated and assembled prior to being approved by MDOT for shipping.

3. Diameter of bolt holes in template shall be 1/16 " larger than anchor bolt diameter.

4. Conduits and anchor bolts shall be rigidly installed before concrete is placed. The center of the template shall coincide with the center of the foundation. The template and handles shall be well supported, horizontally level and firmly anchored in place a minimum of 24 hours after the concrete placement is completed.

5. Due care shall be taken during the concrete placement to avoid displacing the anchor bolts.

6. No hammering on the anchor bolts or template will be allowed.

7. After template is removed, thread nuts on to the bolt flush with the bolt end to protect threads until signal support is erected.

8. For anchor bolt material refer to section 908.14 A and B of the Michigan Standard Specifications for Construction. For anchor bolt installation and tightening refer to section 810.03 N.

9. Dewatering of wet shafts is not allowed. A wet shaft is defined as having more than 3 inches of standing water or as having water infiltrating at a rate equal to or exceeding 12 inches per hour. For wet shafts, Concrete is to be placed in accordance with section 718.03. (wet construction method) with a tremie tube or concrete pump beginning at the shaft bottom. Grade T concrete must be used for underwater placement. Grade S2 may be used in dry excavations only. See MDOT standard specifications Tables 701-1A and 701-1B (Concrete Structure Mixtures).

10. Per MDOT standard specifications 718.02, the Grade S2 acceptable slump range is 6-8 inches. The Grade T acceptable slump range is 7-9 inches.

11. If soil conditions indicate there is no need for a casing pay item as shown on the plans, the contractor should request permission of the engineer to install the foundation without casing.

12. When the casing pay item is included on the plans for a foundation (due to granular soils or a wet hole), steel casing (smooth walled) is to be installed to enable the foundation to be poured. The thickness of the steel is to be determined by the contractor. The steel casing shall be left in place. A suitable method of compaction must be employed to ensure the soil immediately outside the casing is compacted properly.

13. When the casing pay item is called for on the plans, the steel casing may stop at the conduit entrance to foundation. Top of foundation must then be formed separately. The casing pay item quantity will be paid for based on actual linear feet installed.

14. Construct mast arm foundations, according to subsections 718.03 of the Standard Specifications for Construction. All work and materials shall be in accordance with the MDOT Standard Specifications.

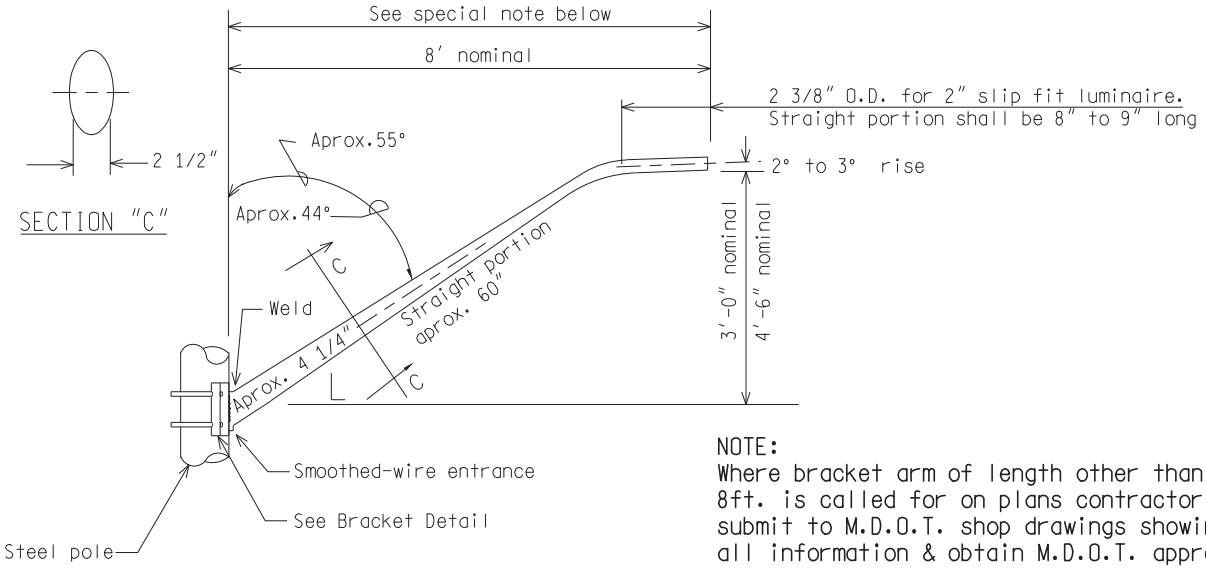
15. Steel reinforcement shall be ASTM A615 grade 60 without epoxy coating.

16. Exposed concrete surfaces shall be cast in forms. Exposed concrete edges shall be beveled 3/4".

17. Steel reinforcement shall have a clear cover of 3 inches unless noted otherwise. Steel Reinforcement may be adjusted to ensure proper clear cover.

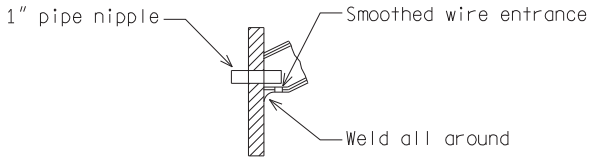
18. Grounding of pole includes adding #4 bare copper ground wire bonded by mechanical connection to foundation reinforcing steel and having 24" of slack above the top of foundation.

NOT TO SCALE

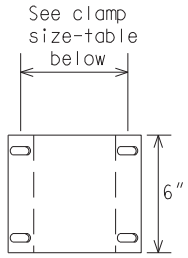


NOTE:
Where bracket arm of length other than 8ft. is called for on plans contractor shall submit to M.D.O.T. shop drawings showing all information & obtain M.D.O.T. approval.

CLAMP ON BRACKET ARM ASSEMBLY (STREET LIGHT)



SECTION "A-A"



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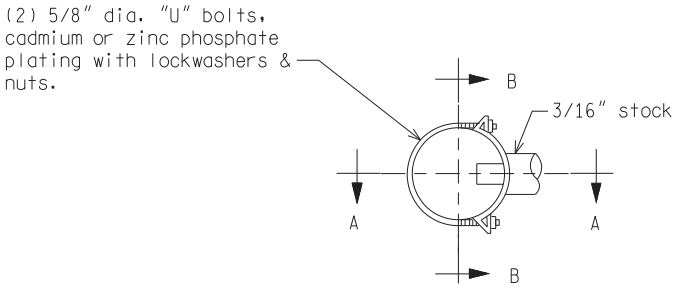


CLAMP SIZE TABLE

TYPE	POLE DIAMETER
A	3.6"- 4.5"
B	6.1"- 6.9"
C	7.5"- 8.5"

BRACKET DETAIL

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG061A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

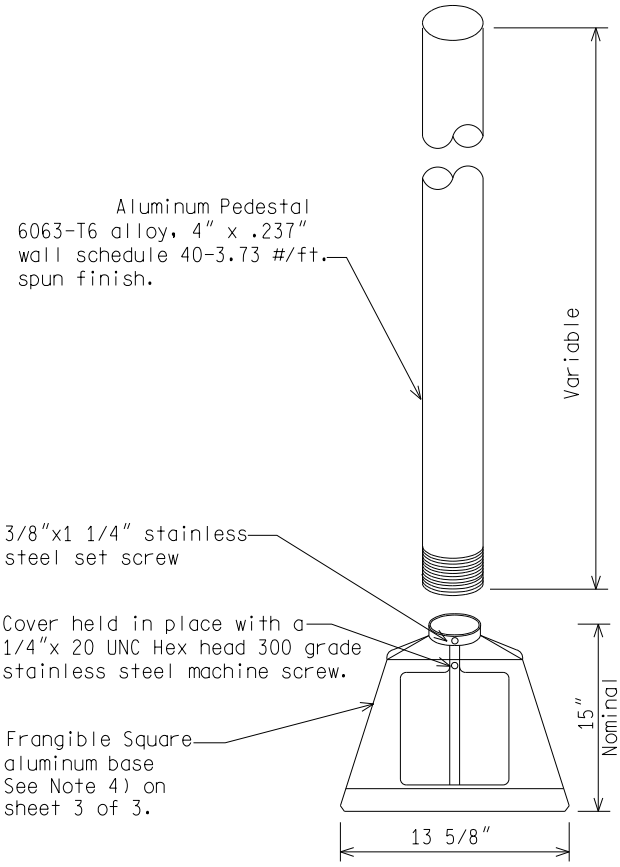
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

CLAMP ON BRACKET ARM ASSEMBLY (STREET LIGHT)

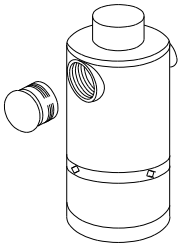
PLAN DATE

SIG-061-A

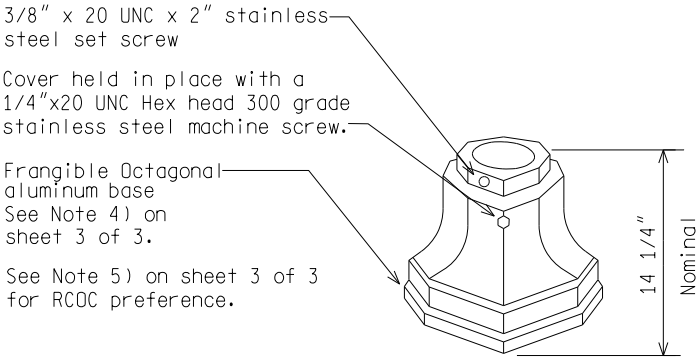
SHEET 1 of 1



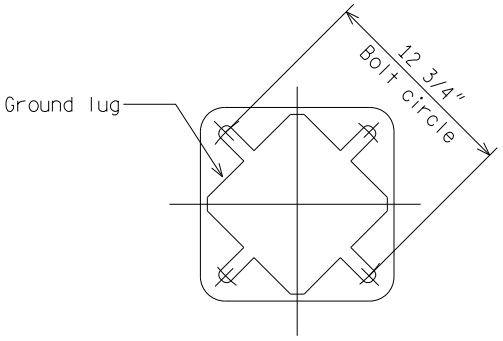
SQUARE ALUMINUM BASE



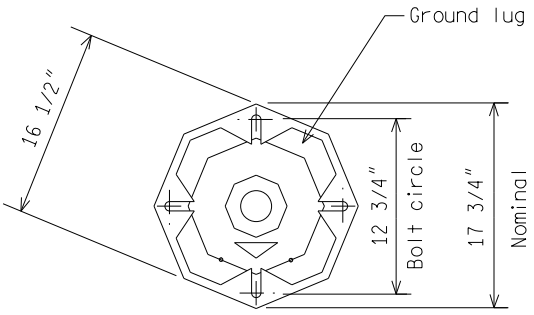
POST TOP
(SLIP FITTER)



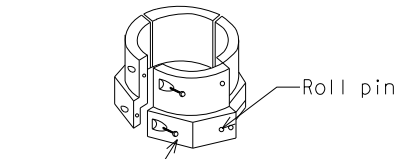
OCTAGONAL BASE



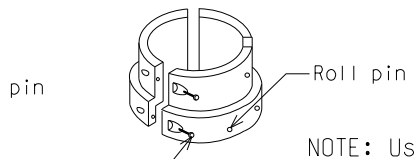
SQUARE BASE
BOTTOM PLAN



OCTAGONAL BASE
BOTTOM PLAN



COLLAR
(OCTAGONAL BASE)



COLLAR
(SQUARE BASE)

NOTE: Use pedestal collar for pedestal length greater than or equal to 14' (typical for 3 color traffic signals with pedestrian signals)

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG070A.dgn Rev. 04/05/21

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

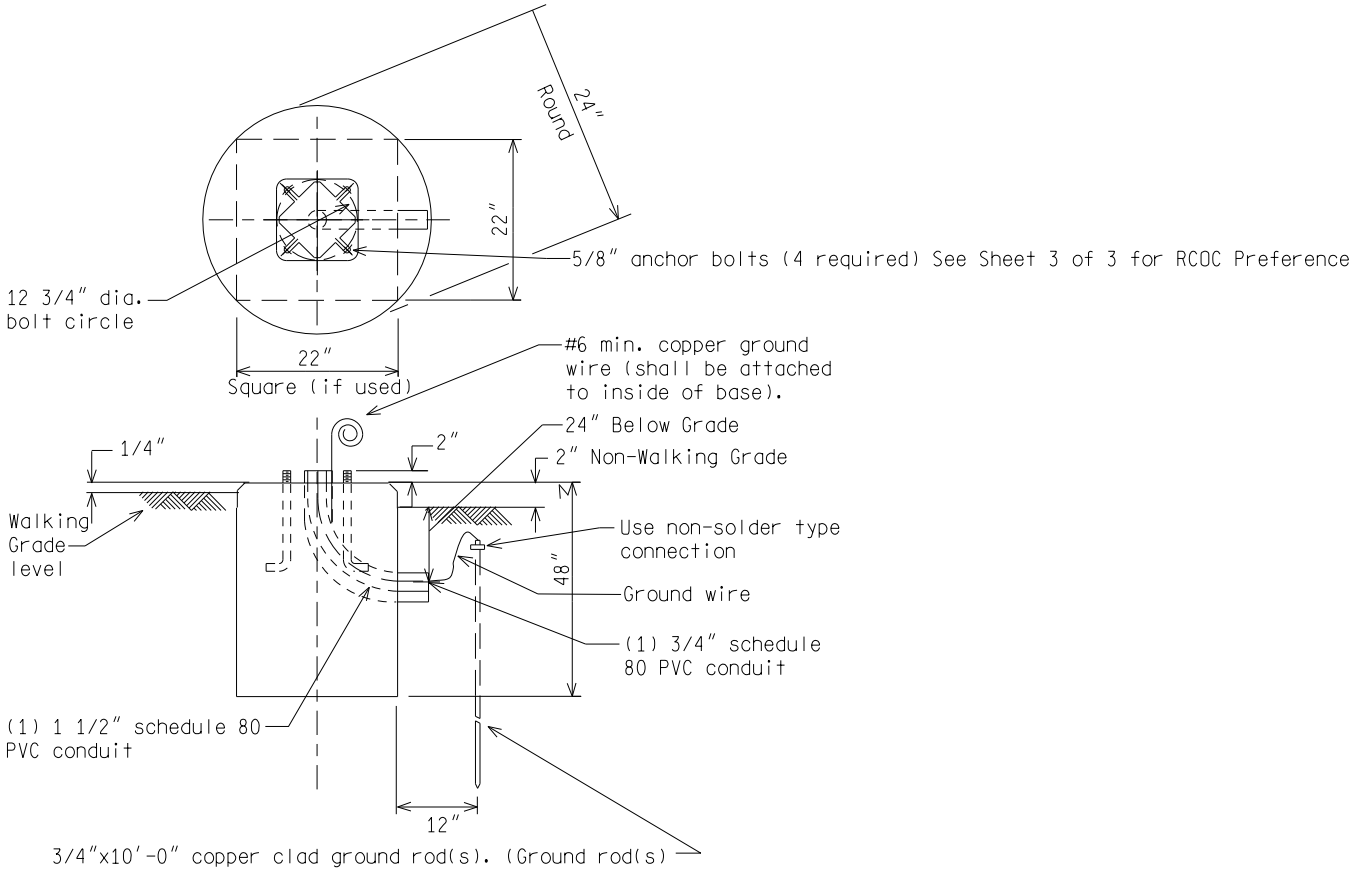
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

PEDESTAL FOUNDATION

PLAN DATE

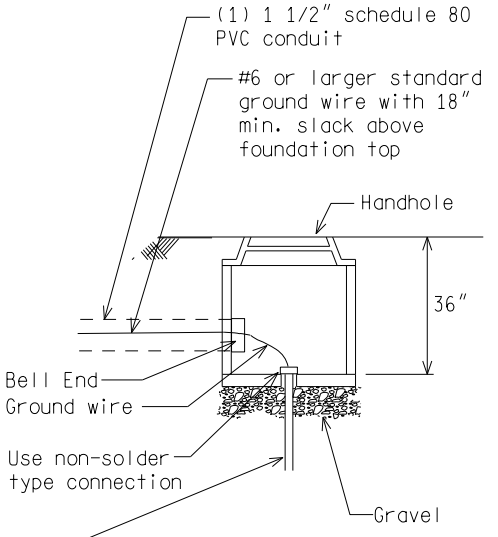
SIG-070-A

SHEET
1 of 3



PEDESTAL FOUNDATION

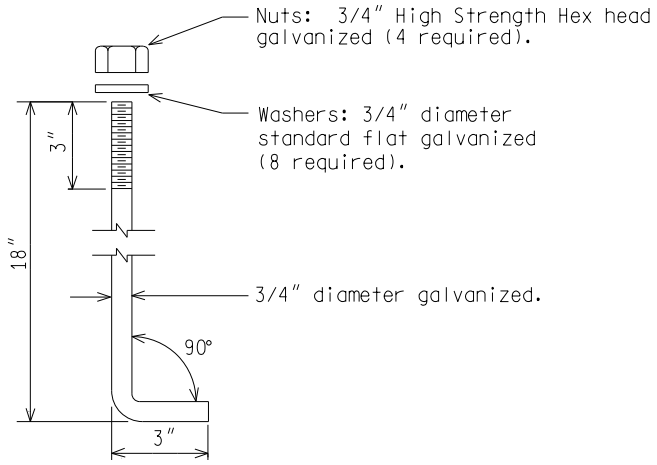
See notes 1, 2 & 3 on sheet 3 of 3.



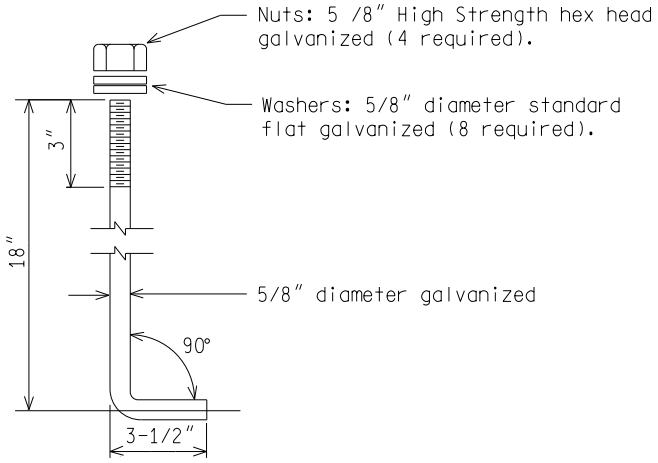
HANDHOLE DETAIL

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG070A.dgn Rev. 04/05/21		PLAN DATE	SIG-070-A	SHEET 2 of 3



For use on MDOT Trunkline.



For use on Oakland County Roads only.

ANCHOR BOLT DETAIL

NOTE: Anchor bolts are to be ASTM-F1554 Grade 36 (Hot dipped galvanized) (4-required)

NOTES:

1) Alternate foundation may be constructed 22"x22" square - 48" deep.

2) Grounding system shall measure 10 ohm or less to ground.

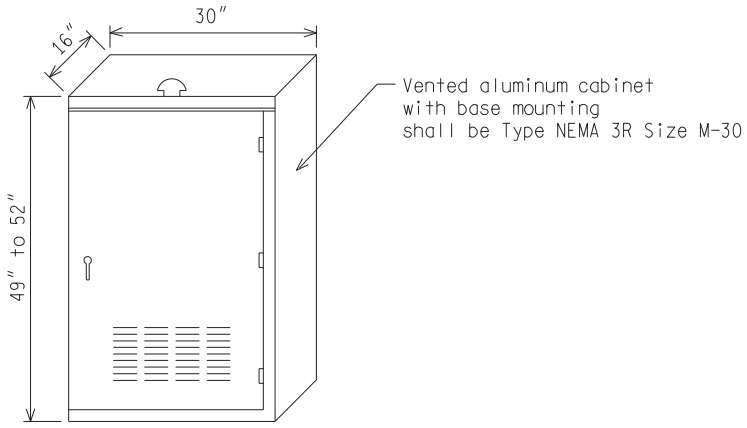
3) Construction joints not permitted in foundation.

4) Pedestal base must meet the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) or Manual for Assessing Safety Hardware (MASH) and have Federal Highway Administration (FHWA) acceptance. Pedestal base must also be certified to have a 4-inch maximum stub height after the support has broken away from its base, as specified in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals and the AASHTO Roadside Design Guide.

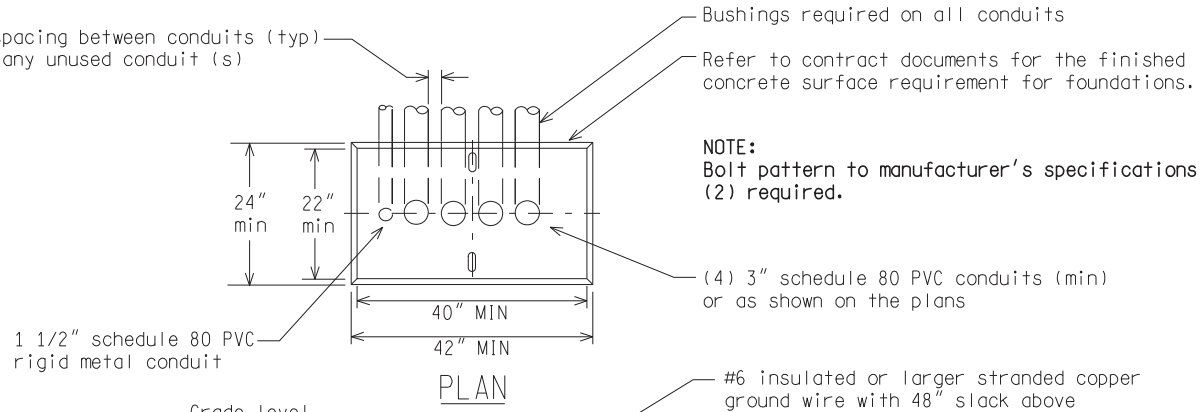
5) Use the Octagonal Base as a preference by the Road Commission for Oakland County (RCOC), for use on Oakland County roads only.

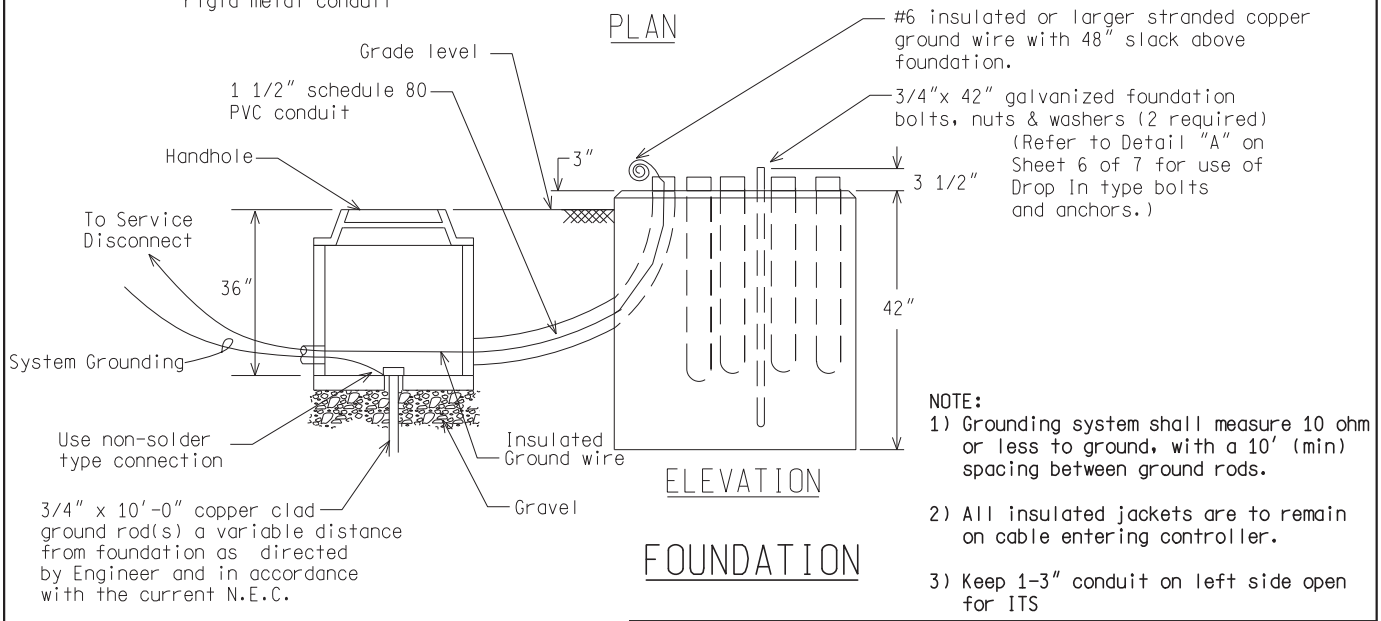
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-070-A	SHEET 3 of 3
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG070A.dgn Rev. 04/05/21		PLAN DATE		



BASE MOUNTED TRAFFIC SIGNAL CONTROLLER CABINET





NOTE:
1) Grounding system shall measure 10 ohm or less to ground, with a 10′ (min) spacing between ground rods.

2) All insulated jackets are to remain on cable entering controller.

3) Keep 1-3″ conduit on left side open for ITS

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

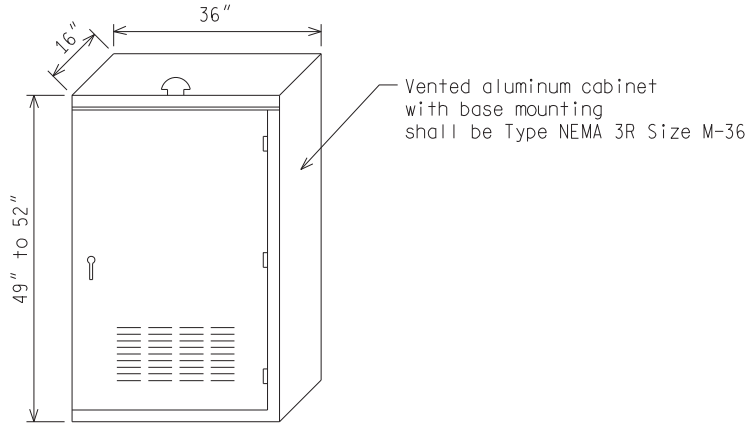
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

BASE MOUNTED T.S.
CONTROLLER CABINET/FOUNDATIONS

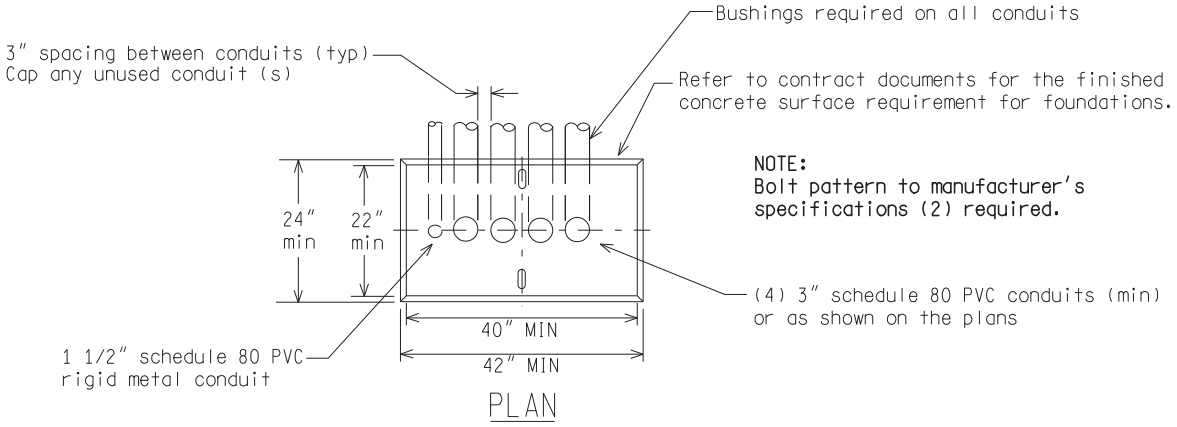
PLAN DATE

SIG-110-A

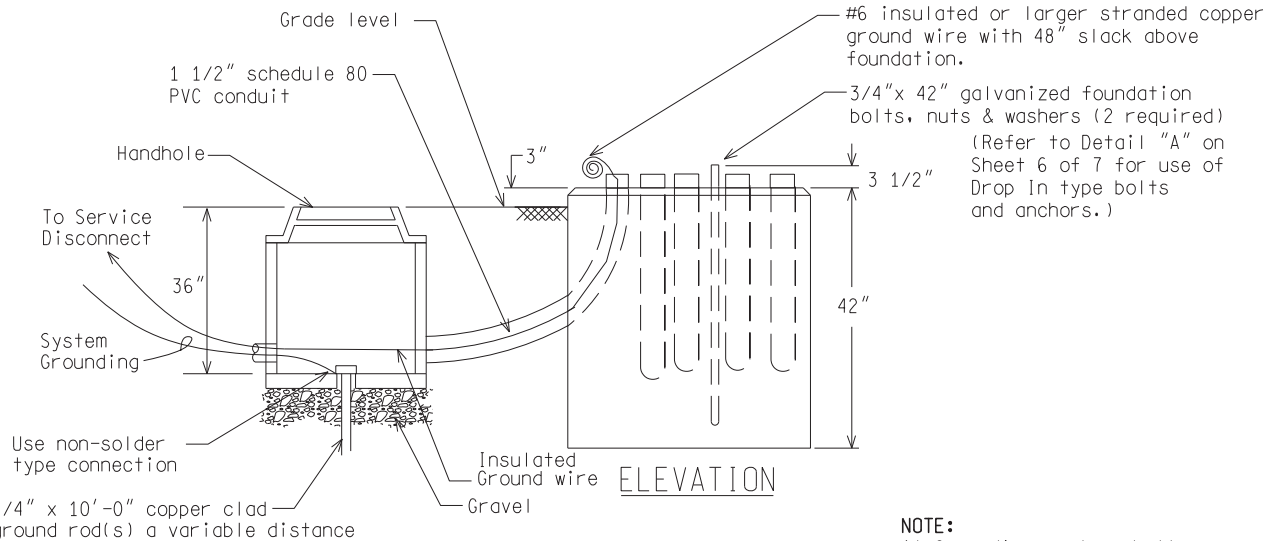
SHEET 1 of 7



BASE MOUNTED TRAFFIC SIGNAL CONTROLLER CABINET



PLAN



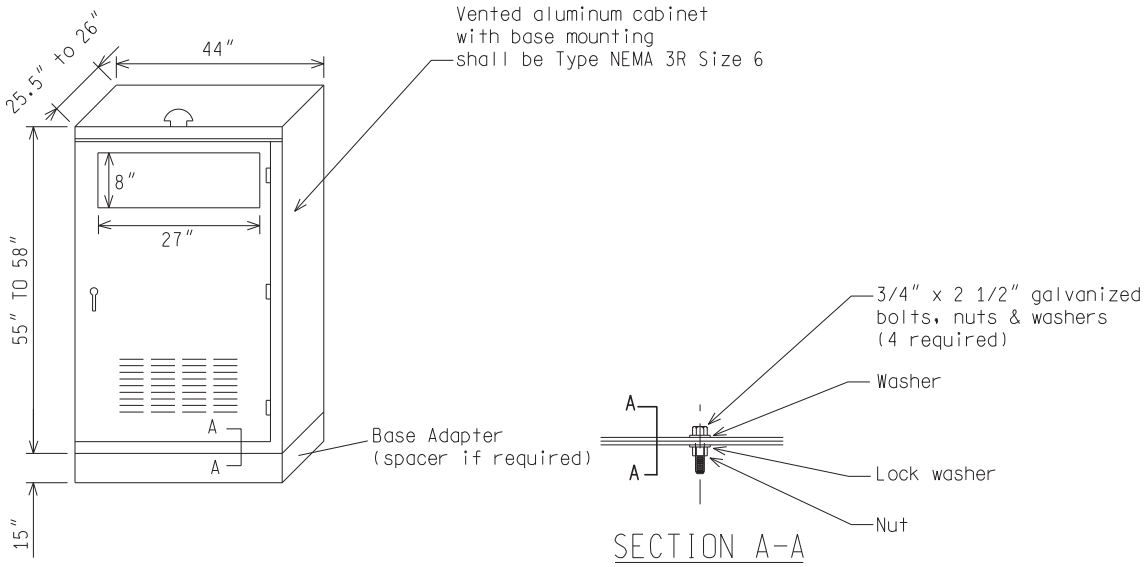
FOUNDATION

NOTE:
1) Grounding system shall measure 10 ohm or less to ground, with a 10' (min) spacing between ground rods.

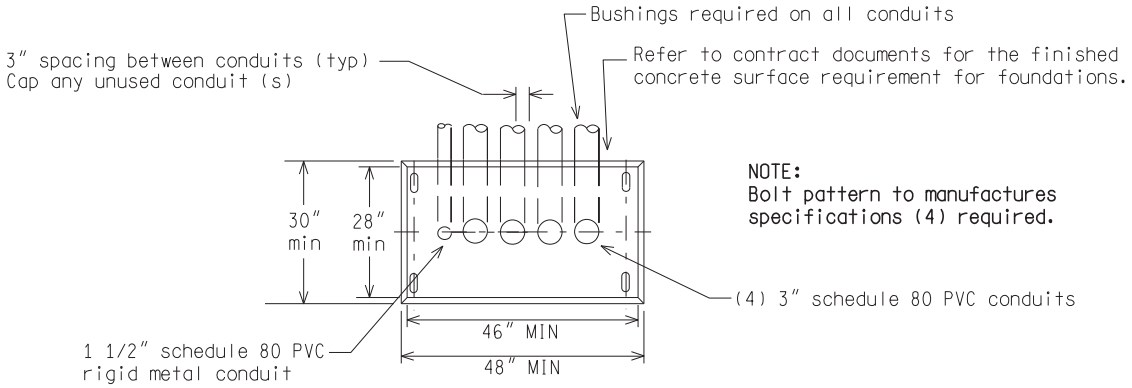
2) All insulated jackets are to remain on cable entering controller.

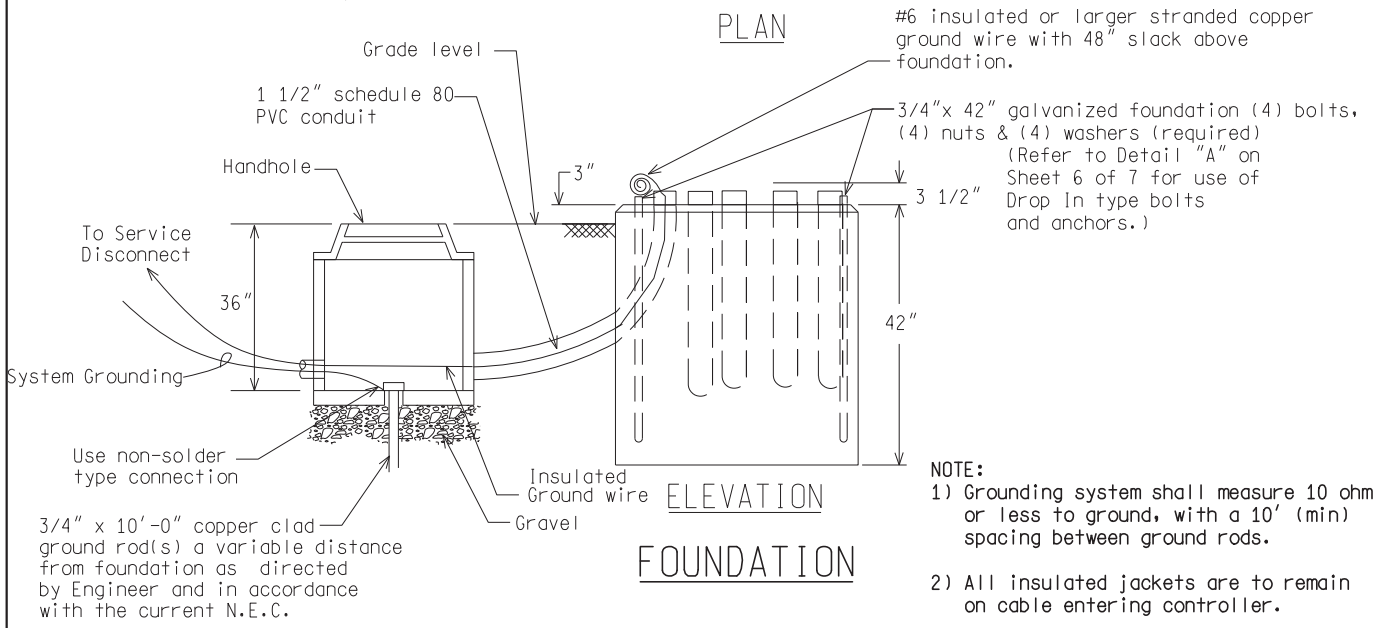
3) Keep 1-3" conduit on left side open for ITS

NOT TO SCALE



BASE MOUNTED TRAFFIC SIGNAL CONTROLLER CABINET





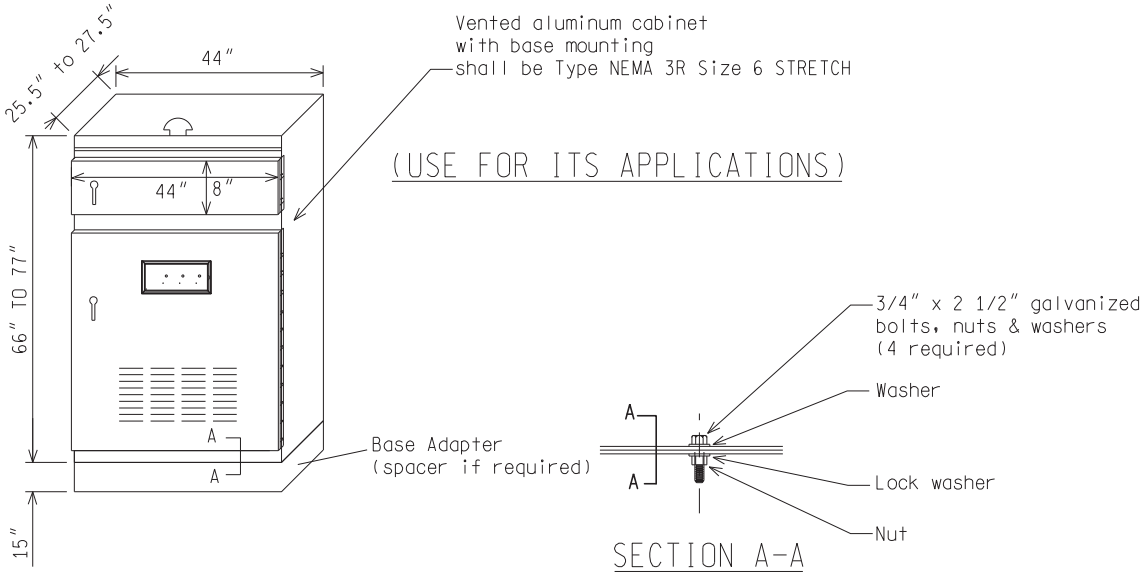
NOTE:
1) Grounding system shall measure 10 ohm or less to ground, with a 10' (min) spacing between ground rods.

2) All insulated jackets are to remain on cable entering controller.

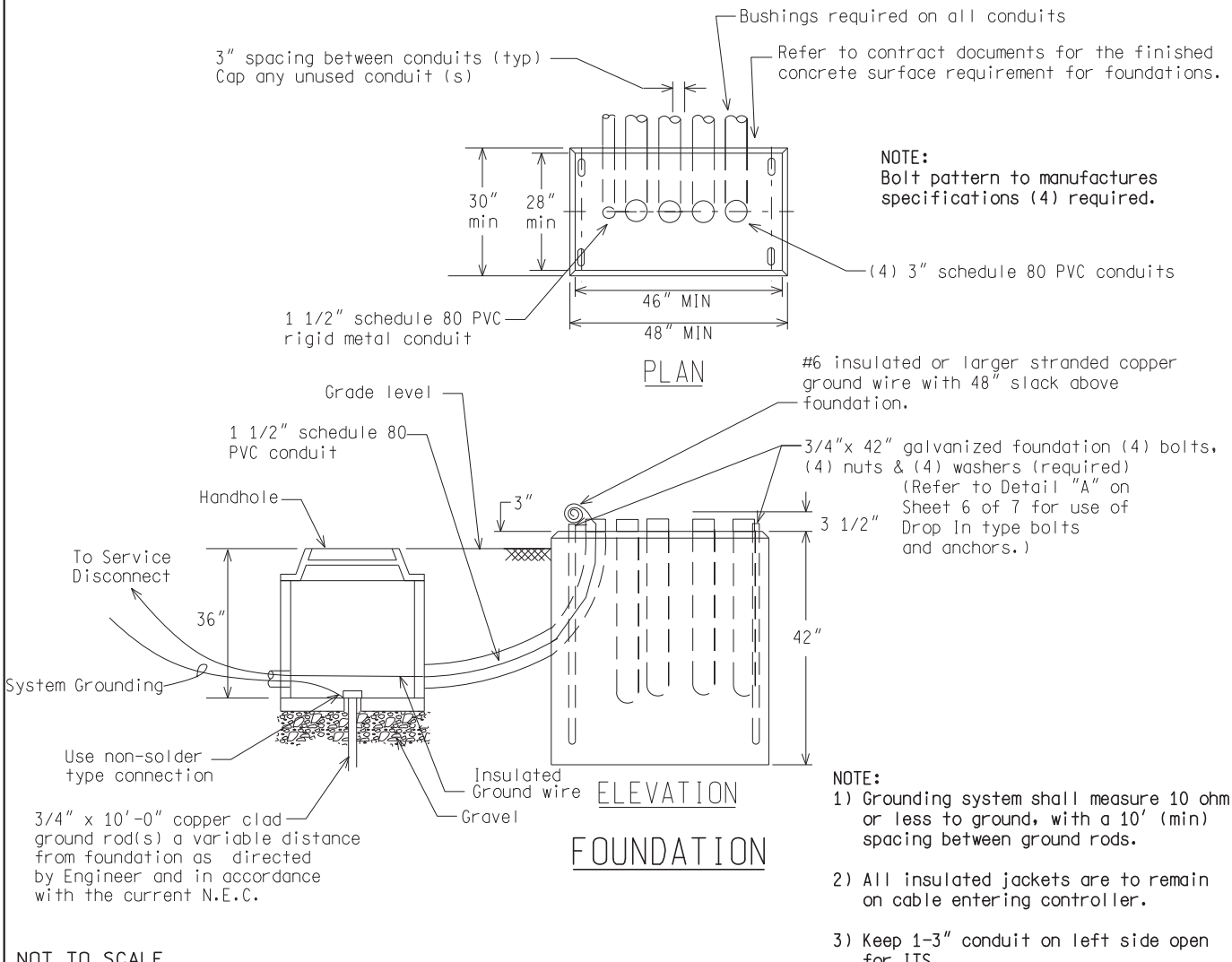
3) Keep 1-3" conduit on left side open for ITS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File:RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev.02/16/17		PLAN DATE	SIG-110-A	SHEET 3 of 7



BASE MOUNTED TRAFFIC SIGNAL ITS CONTROLLER CABINET (IF USED)



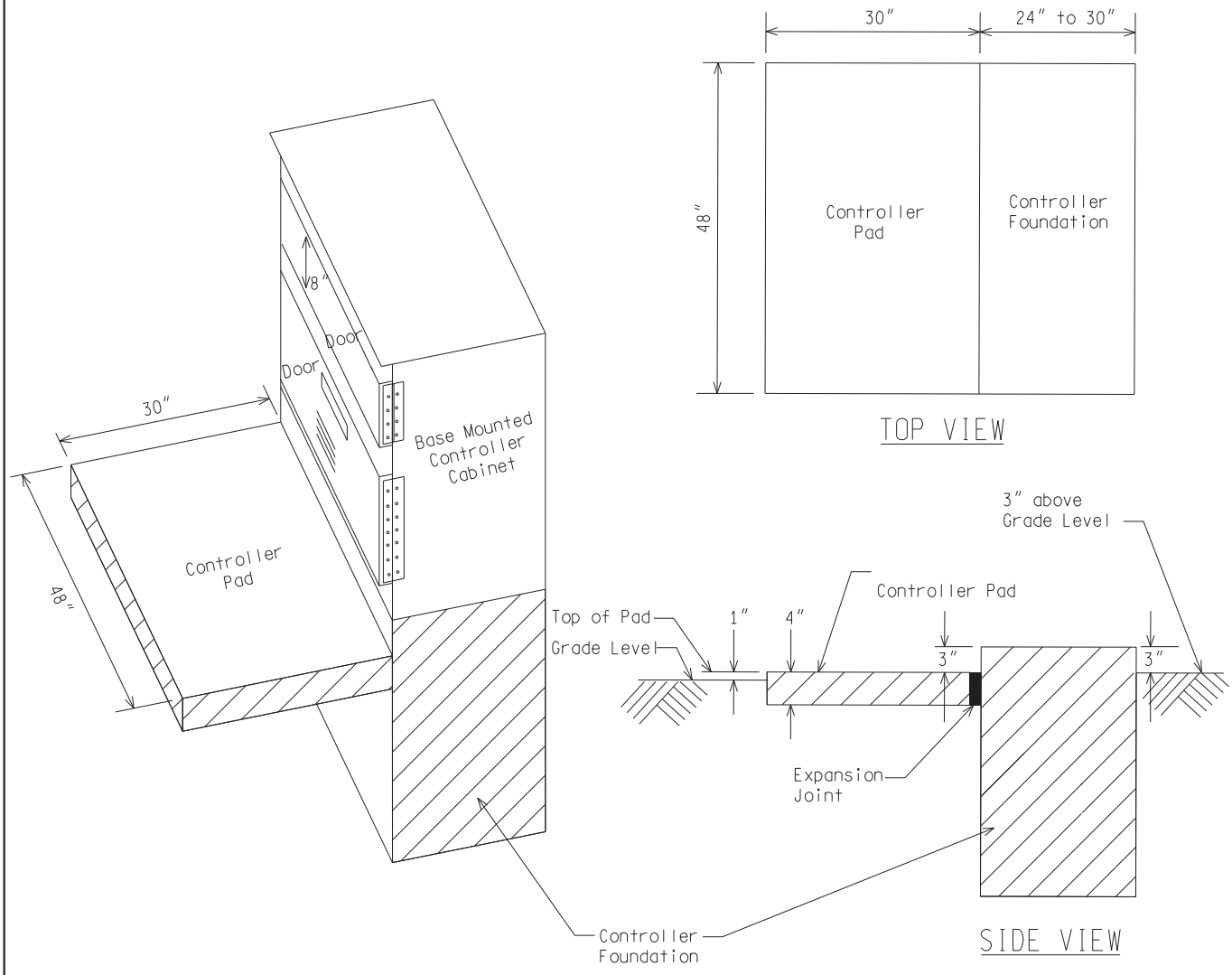
NOTE:
1) Grounding system shall measure 10 ohm or less to ground, with a 10' (min) spacing between ground rods.

2) All insulated jackets are to remain on cable entering controller.

3) Keep 1-3" conduit on left side open for ITS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev. 02/16/17		PLAN DATE	SIG-110-A	SHEET 4 of 7

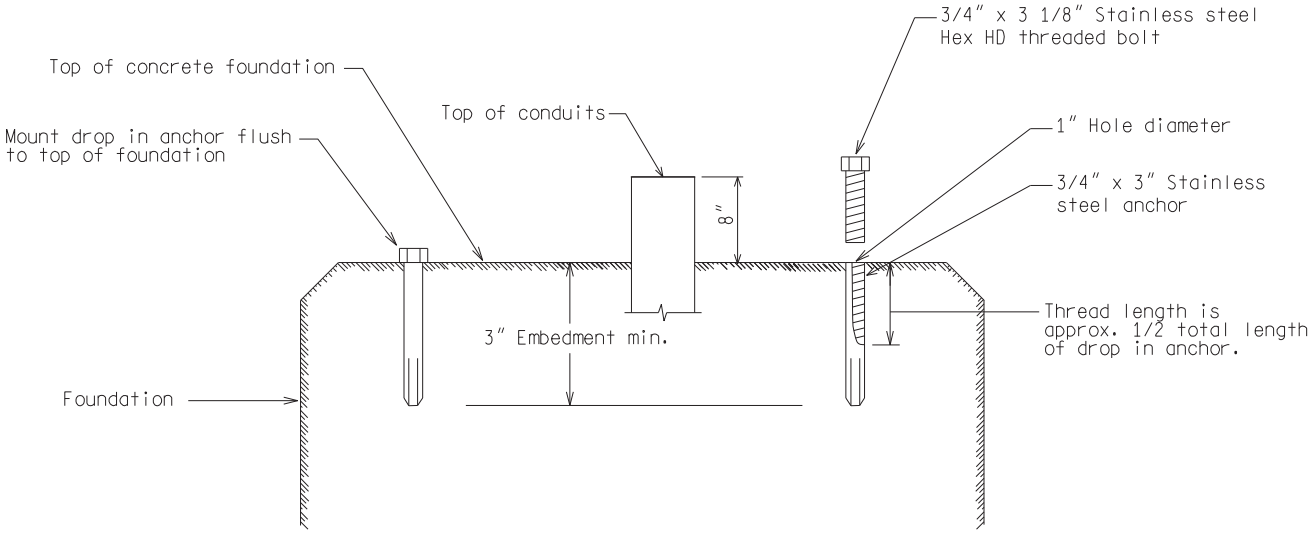


BASE MOUNTED CONTROLLER PAD

NOTE:
Payment for controller pad to be included in controller foundation pay item.
Controller cabinet door to open toward pad.

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-110-A	SHEET 5 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev. 02/16/17		PLAN DATE		

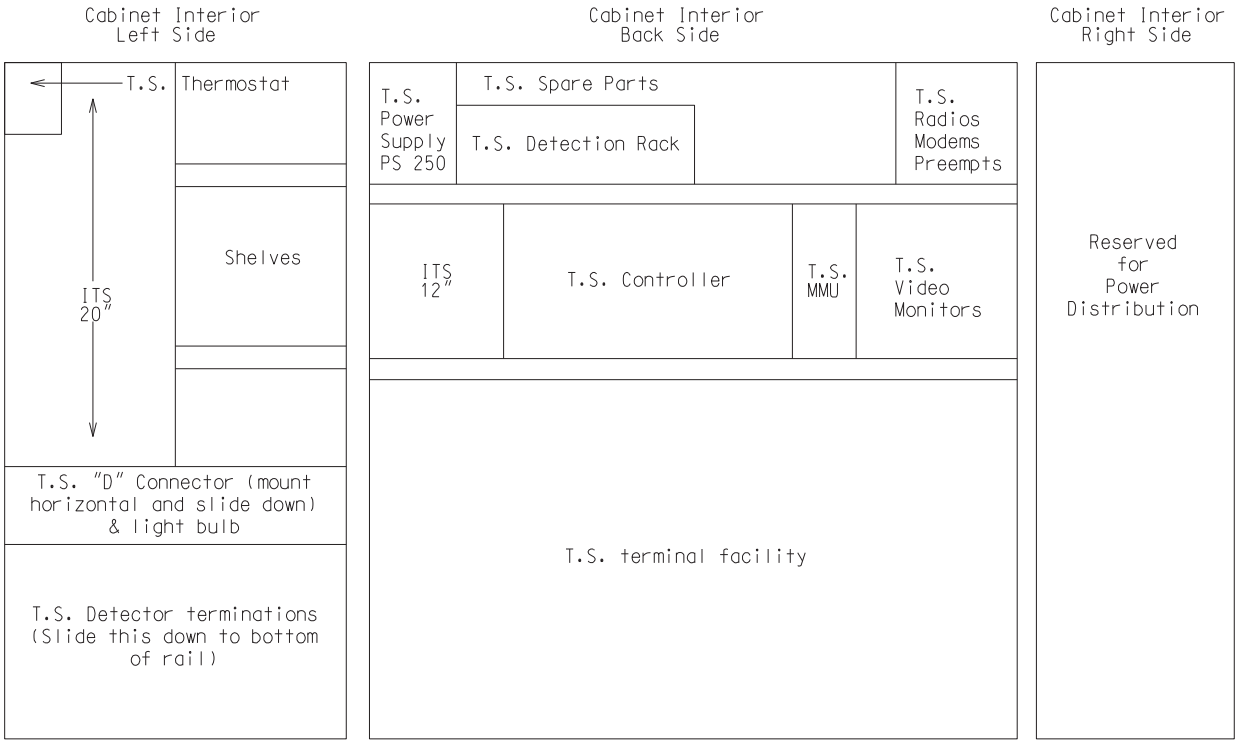


Notes:
1. Use AISI 300 Series Stainless Steel for all bolts and anchors.
2. Use Drop In foundation bolts and anchors as directed by the Engineer.

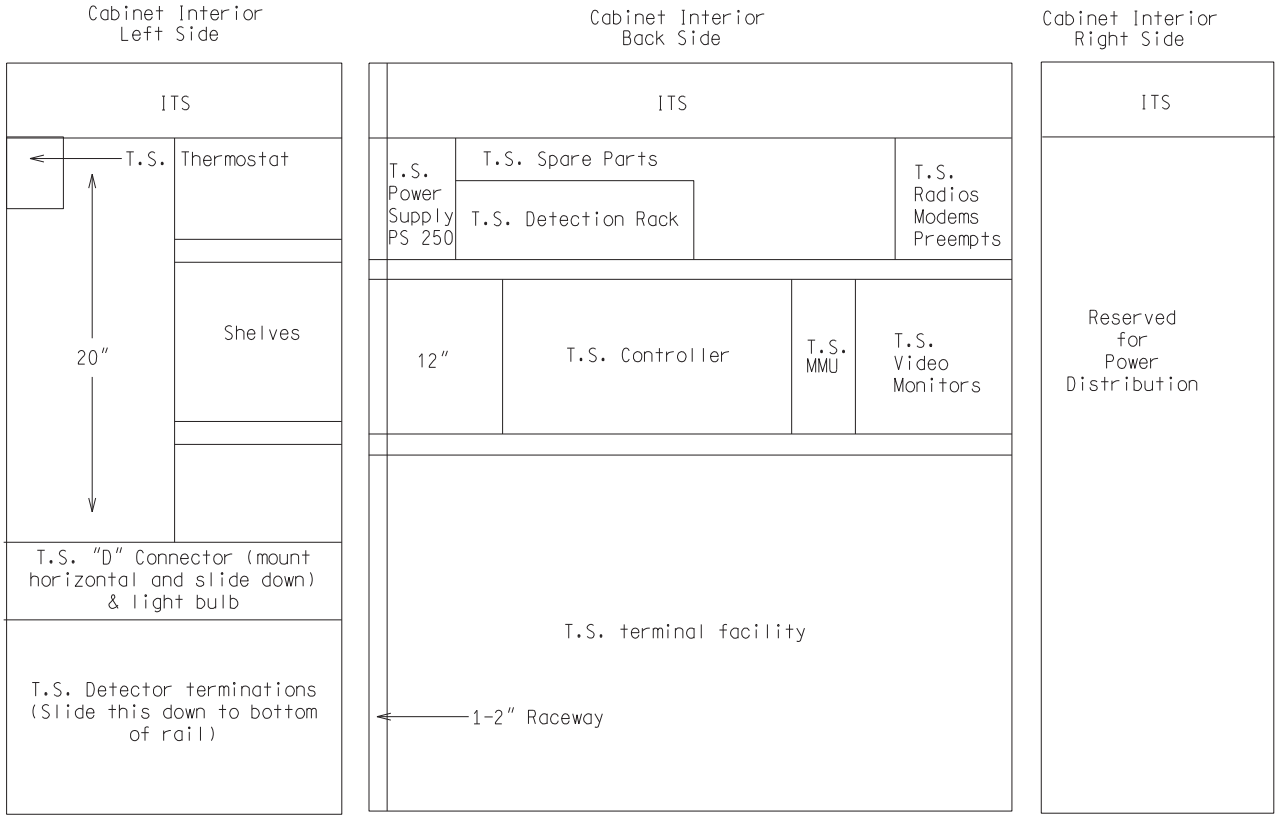
ALTERNATIVE DETAIL "A": DROP IN FOUNDATION BOLTS & ANCHORS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-110-A	SHEET 6 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev. 02/16/17		PLAN DATE		



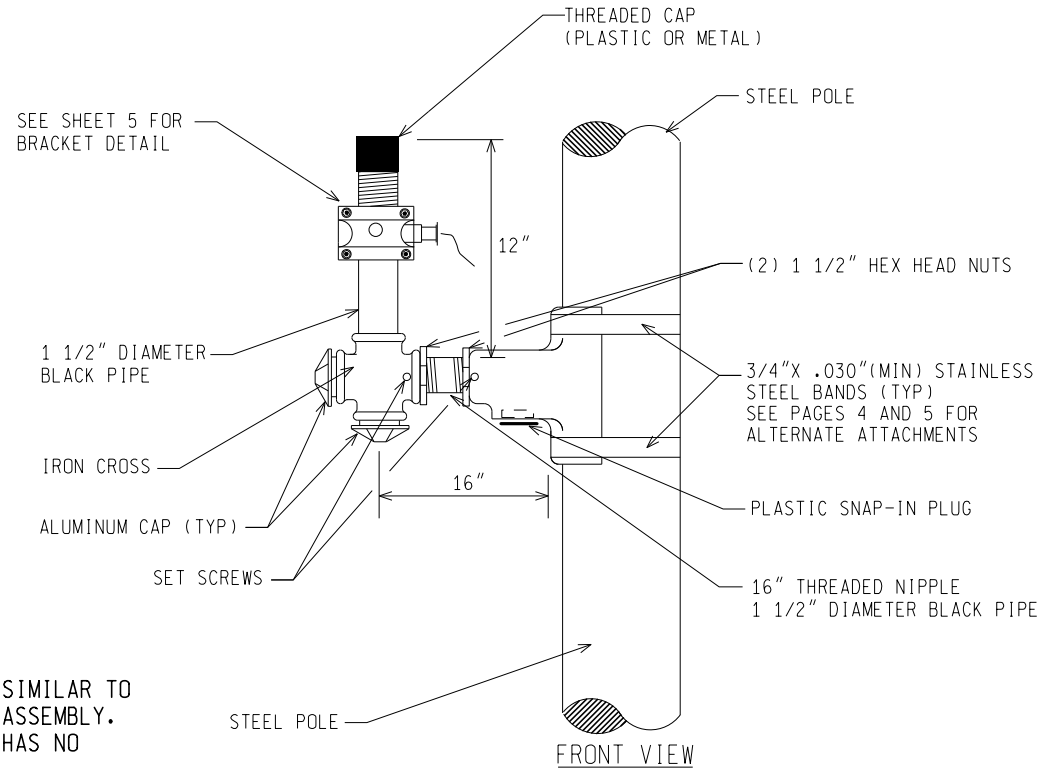
TRAFFIC SIGNAL NEMA 3R SIZE 6 CABINET REQUIREMENTS



TRAFFIC SIGNAL NEMA 3R SIZE 6 STRETCH CABINET REQUIREMENTS FOR ITS APPLICATIONS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-110-A	SHEET 7 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG110A.dgn Rev. 02/16/17		PLAN DATE		



(*) NOTE:
ANTENNA ATTACHMENT SIMILAR TO PED SIGNAL BRACKET ASSEMBLY. (FINISHED ASSEMBLY HAS NO THREADS EXPOSED.)

ANTENNA ATTACHMENT DETAIL (STEEL POLE) FOR REMOTE LOCATION

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/2018

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DSP

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

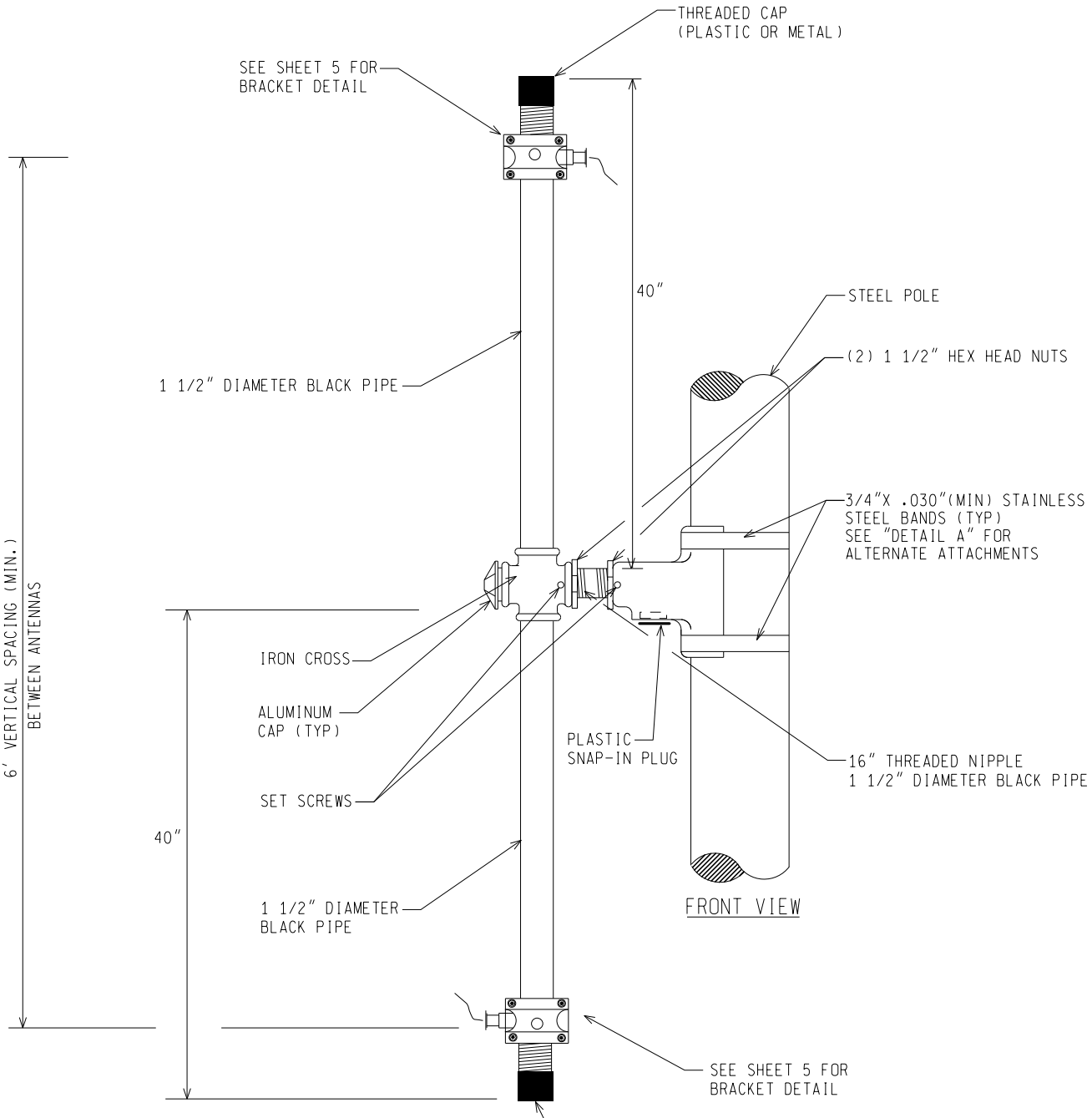
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

ANTENNA ATTACHMENT DETAIL

PLAN DATE

SIG-130-B

SHEET 1 of 6

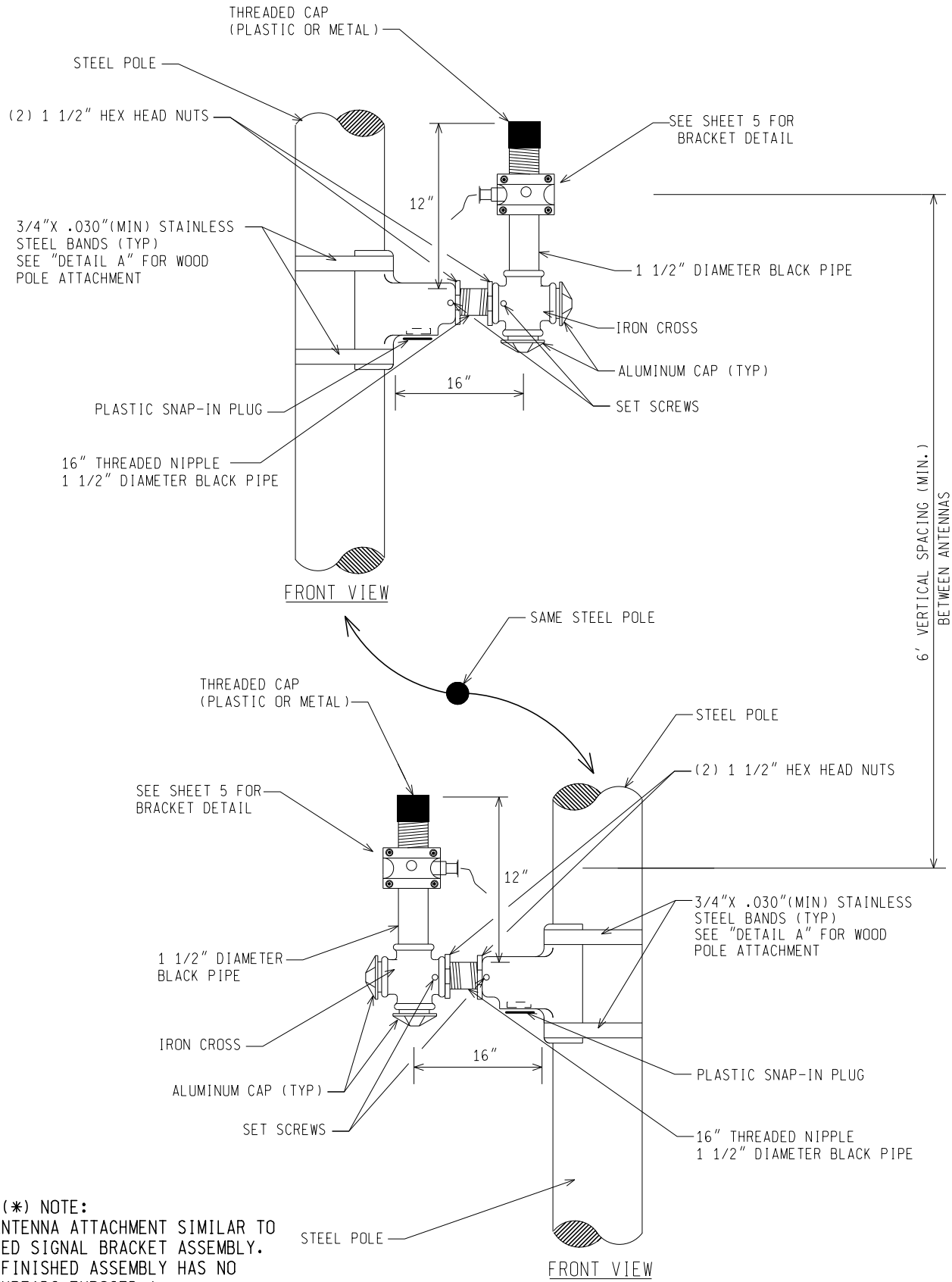


(*) NOTE:
ANTENNA ATTACHMENT SIMILAR TO
PED SIGNAL BRACKET ASSEMBLY.
(FINISHED ASSEMBLY HAS NO
THREADS EXPOSED.)

ANTENNA ATTACHMENT DETAIL (STEEL POLE)
FOR MASTER OR REPEATER LOCATION
SINGLE BRACKET METHOD PREFERRED

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-130-B	SHEET 2 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/18		PLAN DATE		

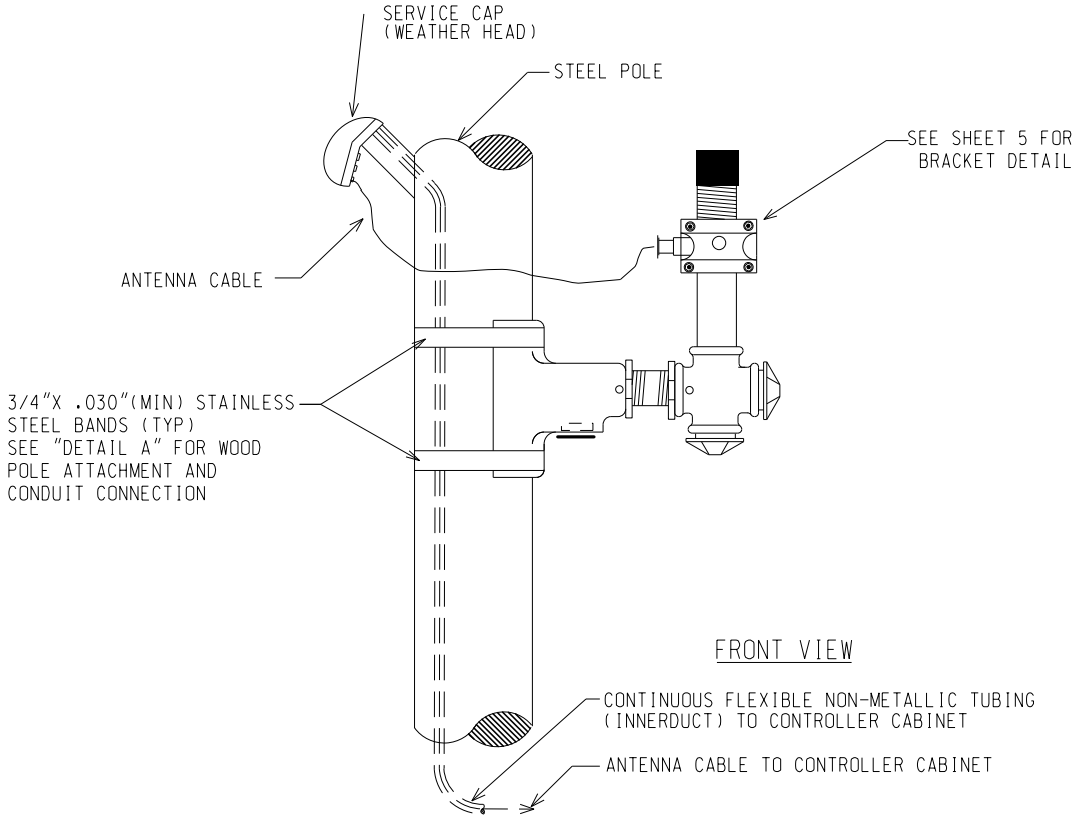


(*) NOTE:
ANTENNA ATTACHMENT SIMILAR TO PED SIGNAL BRACKET ASSEMBLY. (FINISHED ASSEMBLY HAS NO THREADS EXPOSED.)

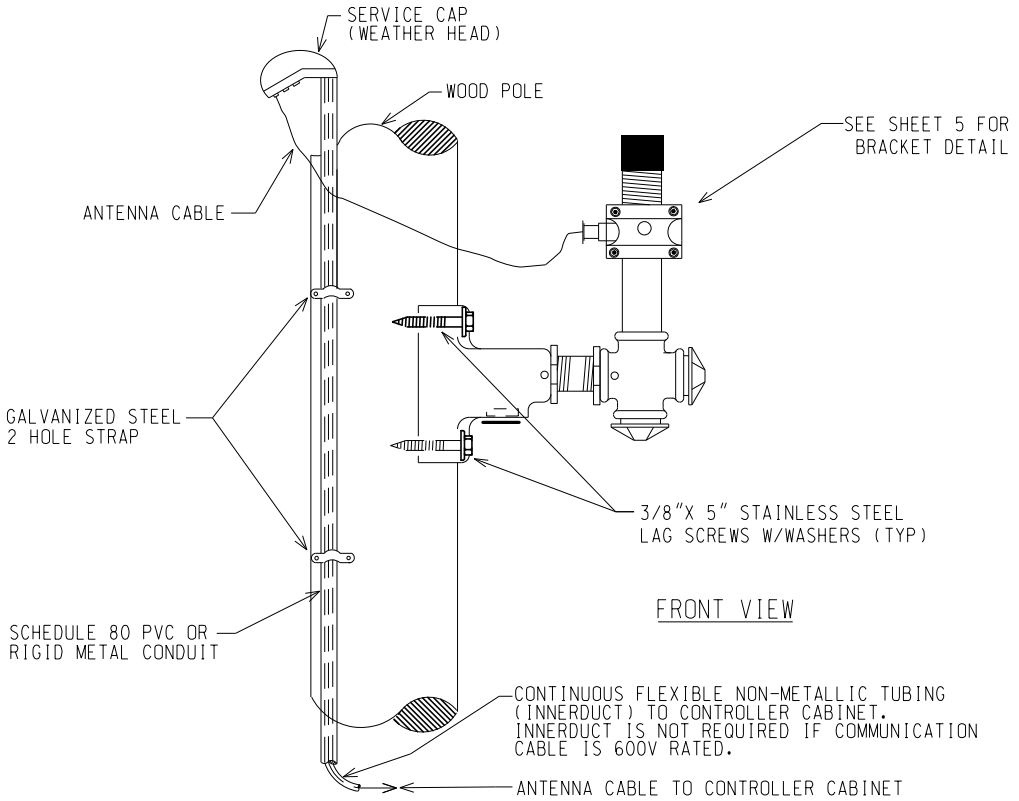
ANTENNA ATTACHMENT DETAIL (STEEL POLE)
FOR MASTER OR REPEATER LOCATION
USE WHEN 2 BRACKETS ARE REQUIRED

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-130-B	SHEET 3 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/18		PLAN DATE		



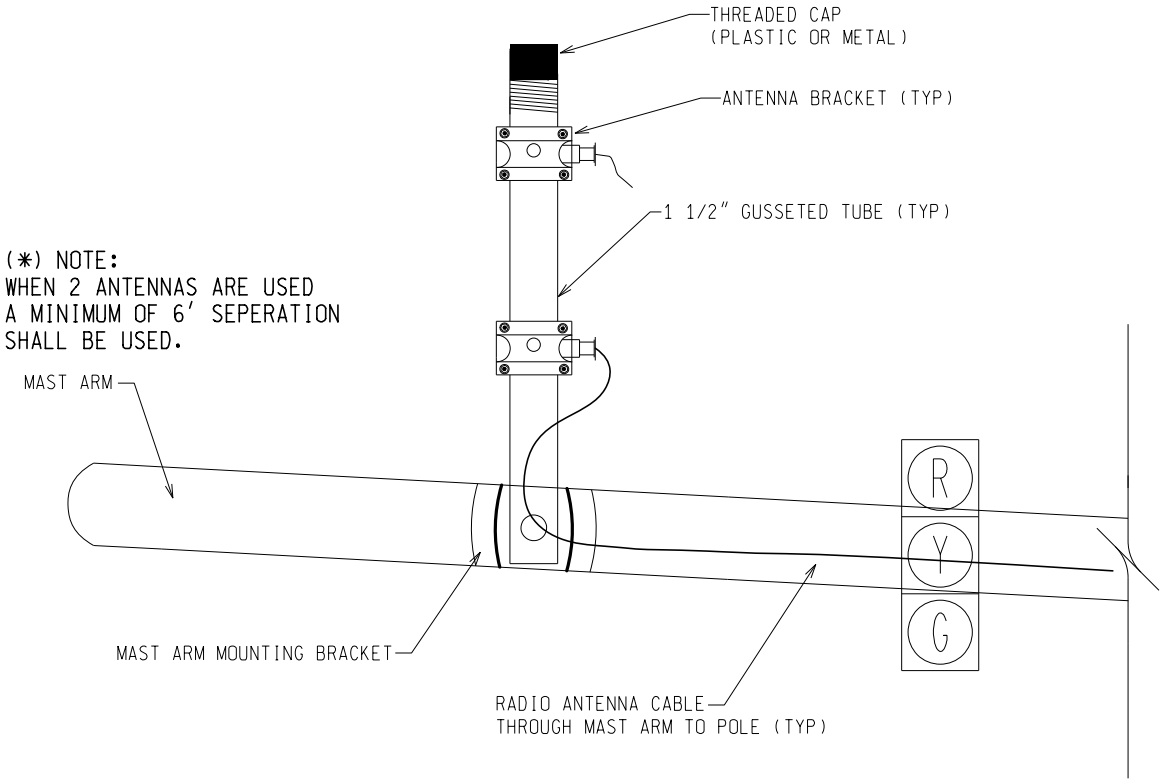
ANTENNA ATTACHMENT DETAIL (STEEL POLE)



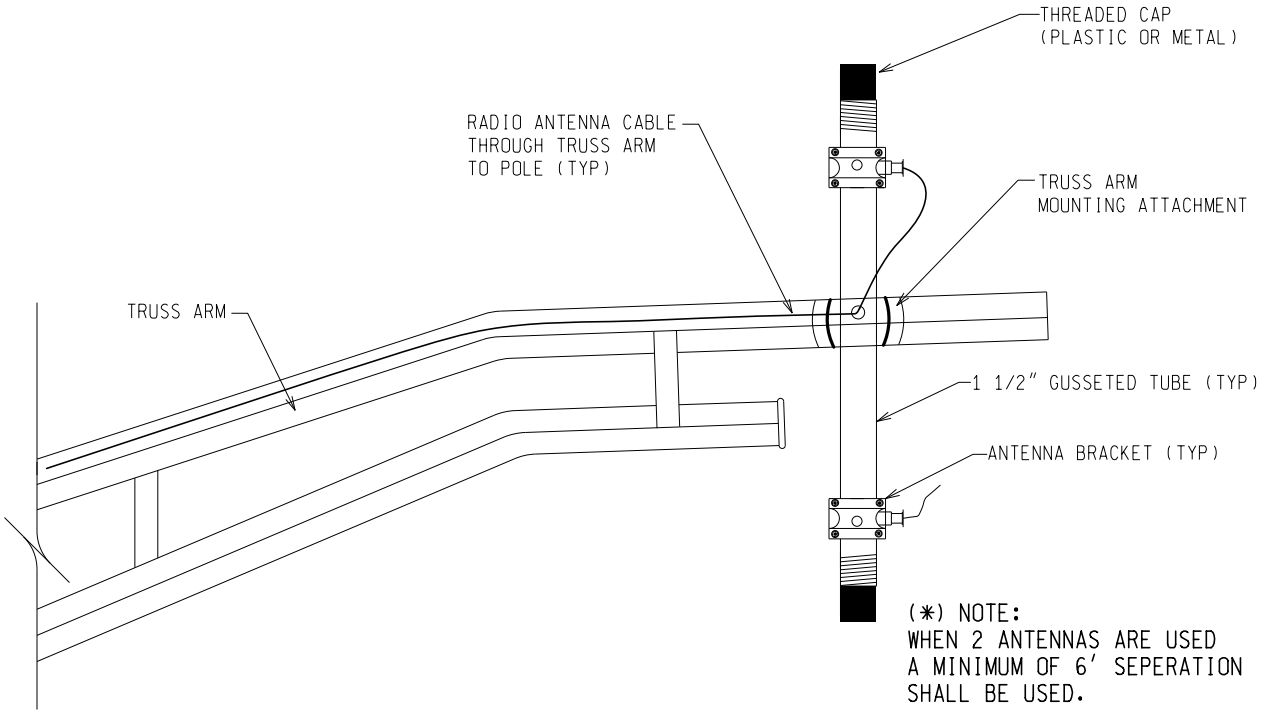
ANTENNA ATTACHMENT DETAIL (WOOD POLE)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-130-B	SHEET 4 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/18		PLAN DATE		



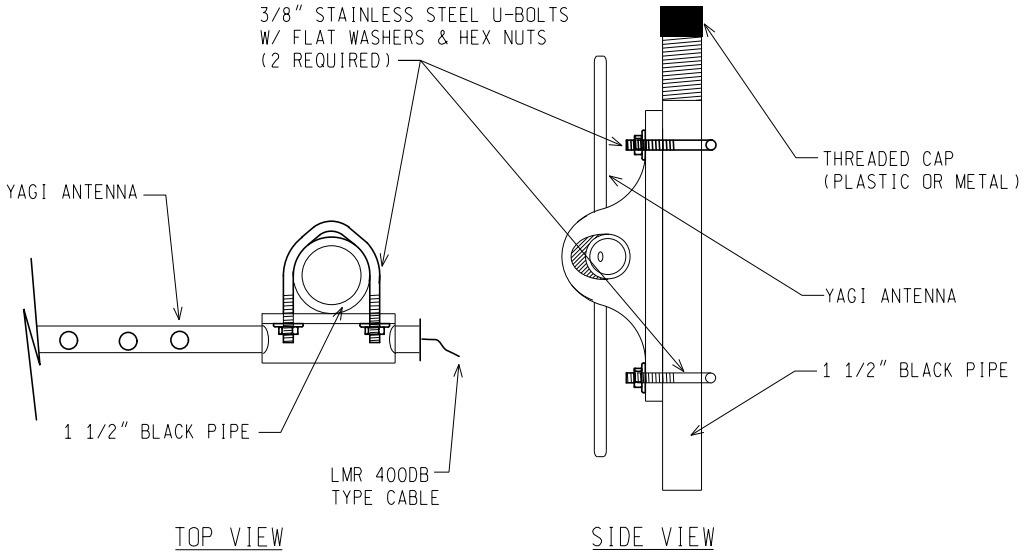
ANTENNA ATTACHMENT DETAIL (MAST ARM)



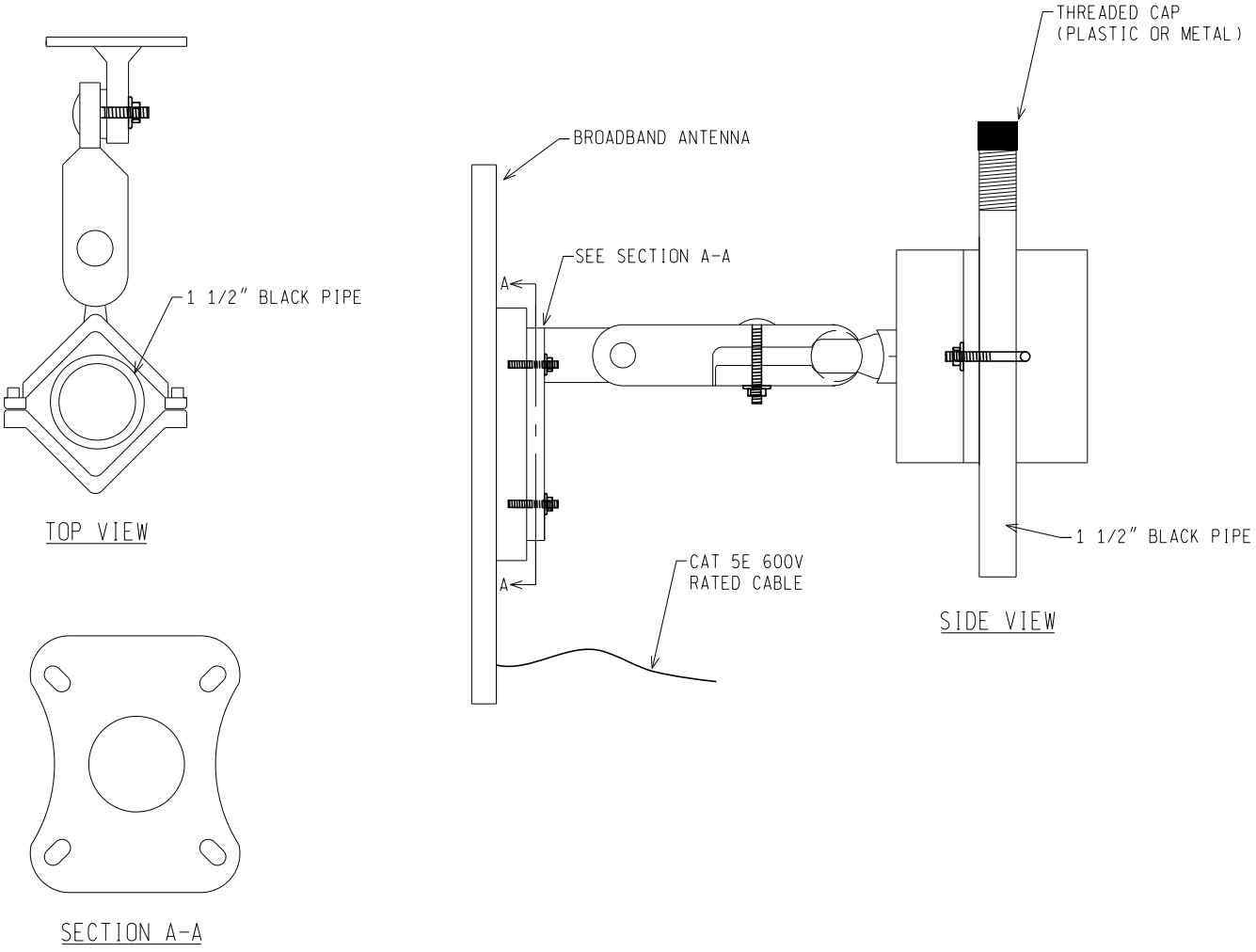
ANTENNA ATTACHMENT DETAIL (TRUSS ARM)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-130-B	SHEET 5 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/18		PLAN DATE		



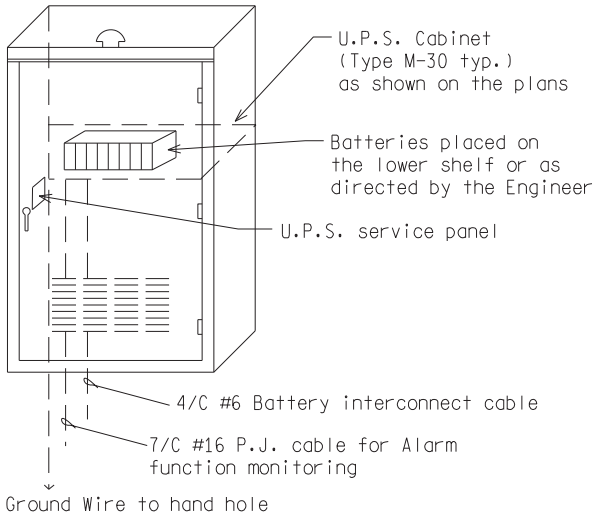
YAGI ANTENNA BRACKET ATTACHMENT DETAIL



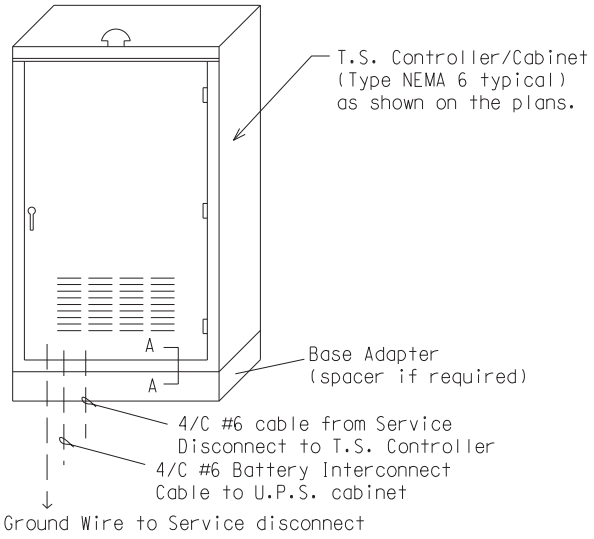
BROADBAND ANTENNA BRACKET ATTACHMENT DETAIL

NOT TO SCALE

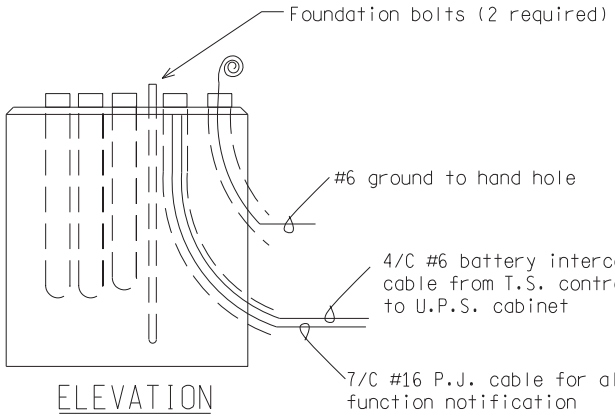
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-130-B	SHEET 6 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG130B.dgn Rev. 02/06/18		PLAN DATE		



U.P.S. CABINET BASE MOUNTED



TRAFFIC SIGNAL CONTROLLER/ CABINET BASE MOUNTED

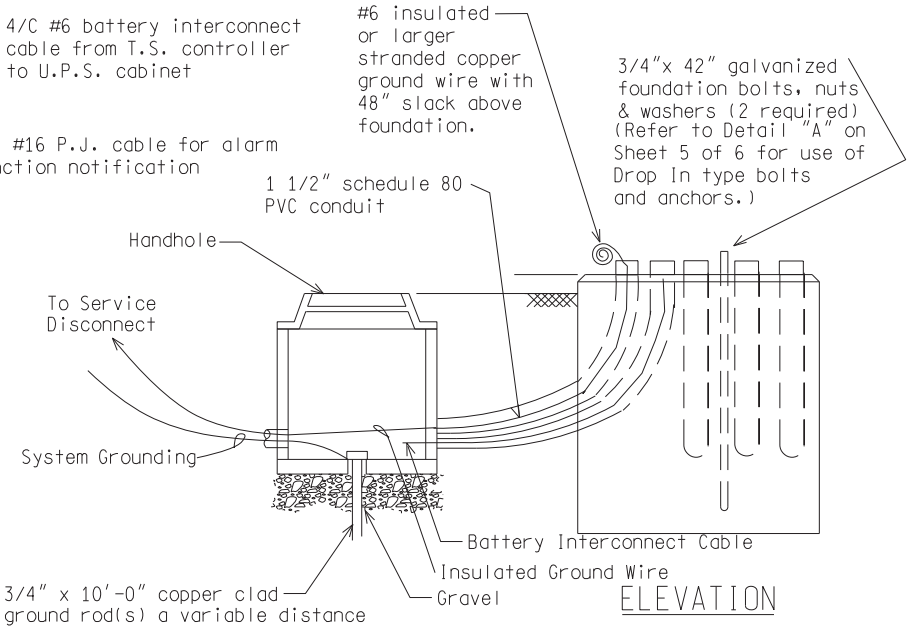


CABINET FOUNDATION

NOTE:
1. Refer to SIG-011-A for Controller Cabinet Mounting on Steel or Wood Pole

2. Refer to SIG-045-A for T.S. Base Mounted Controller Cabinet foundations.

3. Refer to SIG-153-A for strain pole foundation details.



CABINET FOUNDATION

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG140A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

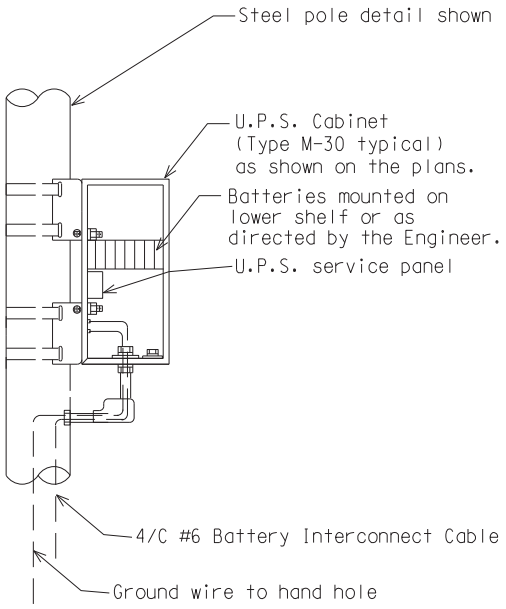
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

TRAFFIC SIGNAL UNINTERRUPTIBLE POWER SYSTEM

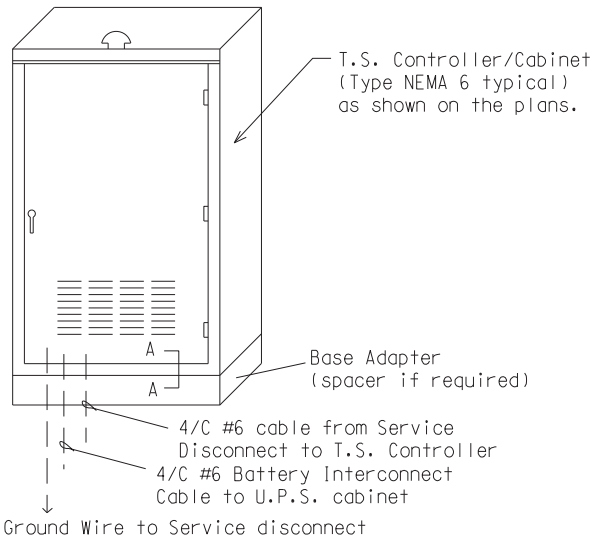
PLAN DATE

SIG-140-A

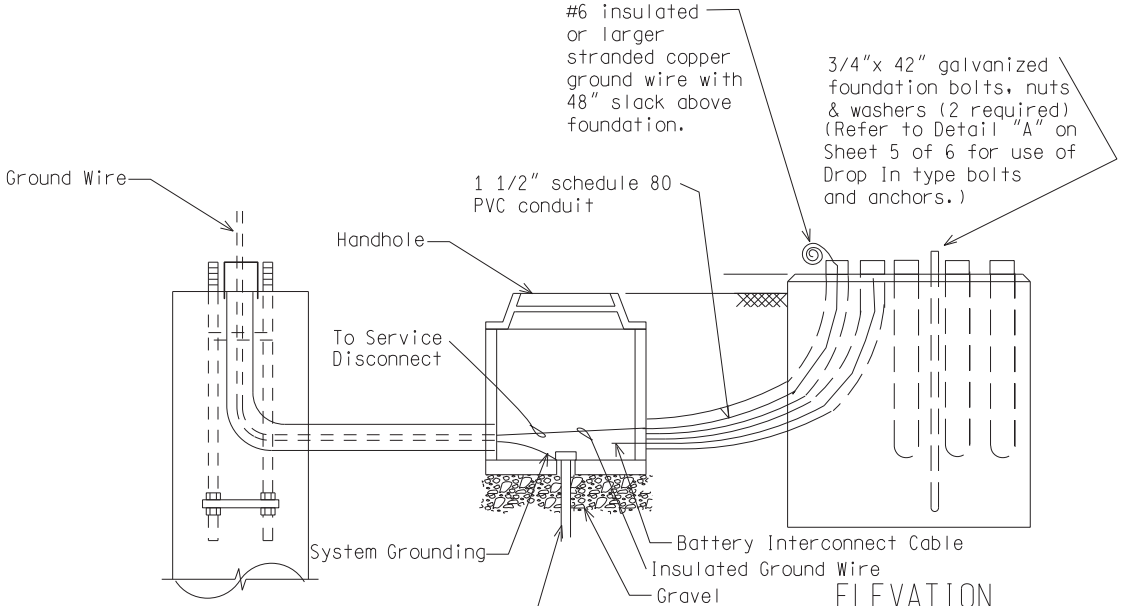
SHEET 1 of 2



U.P.S. CABINET POLE MOUNTED



TRAFFIC SIGNAL CONTROLLER/ CABINET BASE MOUNTED



ANCHOR BASE STEEL STRAIN POLE FOUNDATION

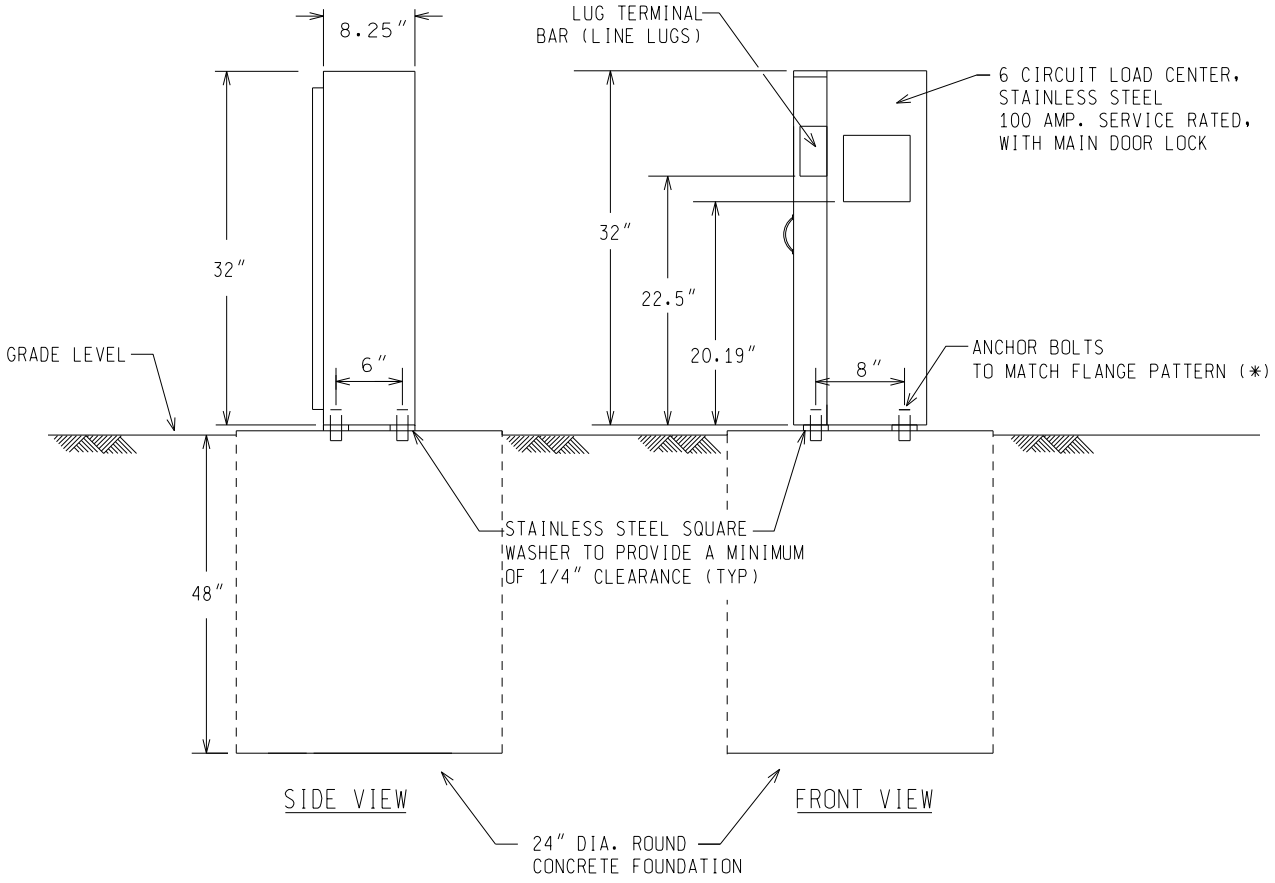
CABINET FOUNDATION

3/4" x 10'-0" copper clad
ground rod(s) a variable distance
from foundation as directed
by Engineer and in accordance
with the current N.E.C.

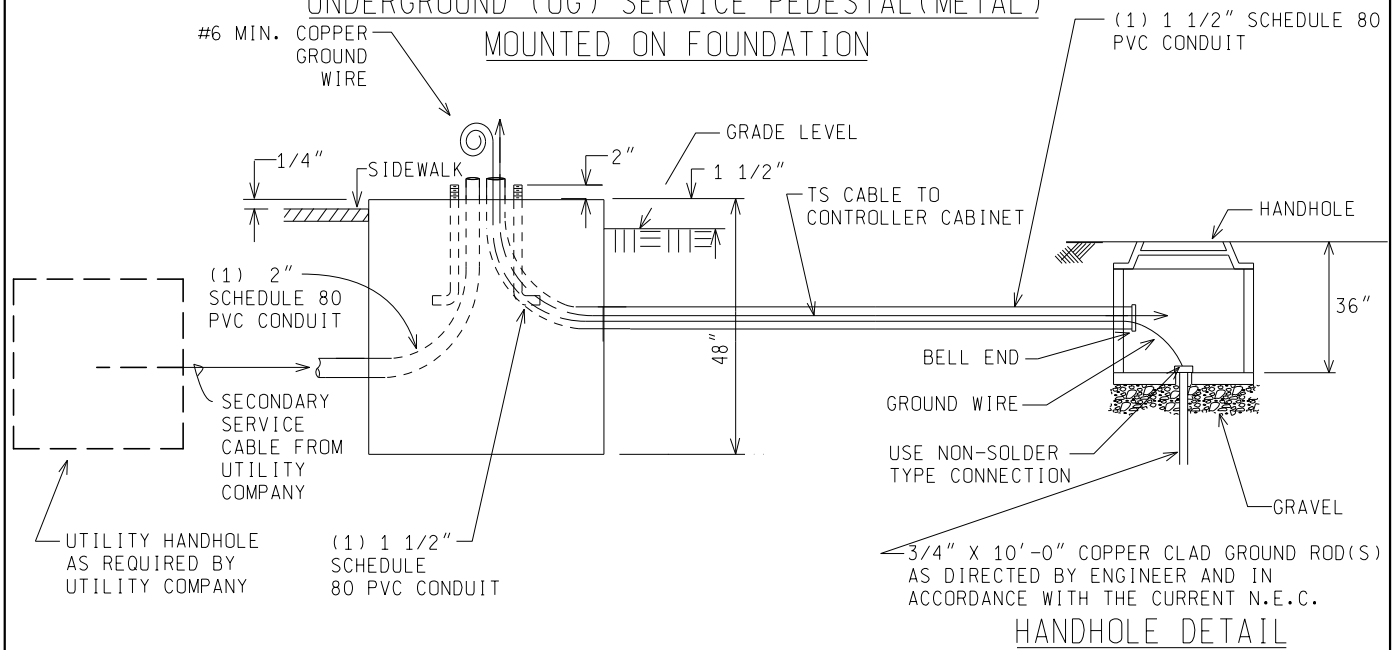
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-140-A	SHEET 2 of 2
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG140A.dgn Rev. 02/16/17		PLAN DATE		

(*) NOTE: STAINLESS STEEL ANCHOR BOLTS OR STAINLESS STEEL DROP INS, TO BE USED ON EXISTING FOUNDATIONS WITH PROPER GRADE AND SIZE.



UNDERGROUND (UG) SERVICE PEDESTAL(METAL) MOUNTED ON FOUNDATION



HANDHOLE DETAIL

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG210B.dgn Rev. 02/06/18

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DSP

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

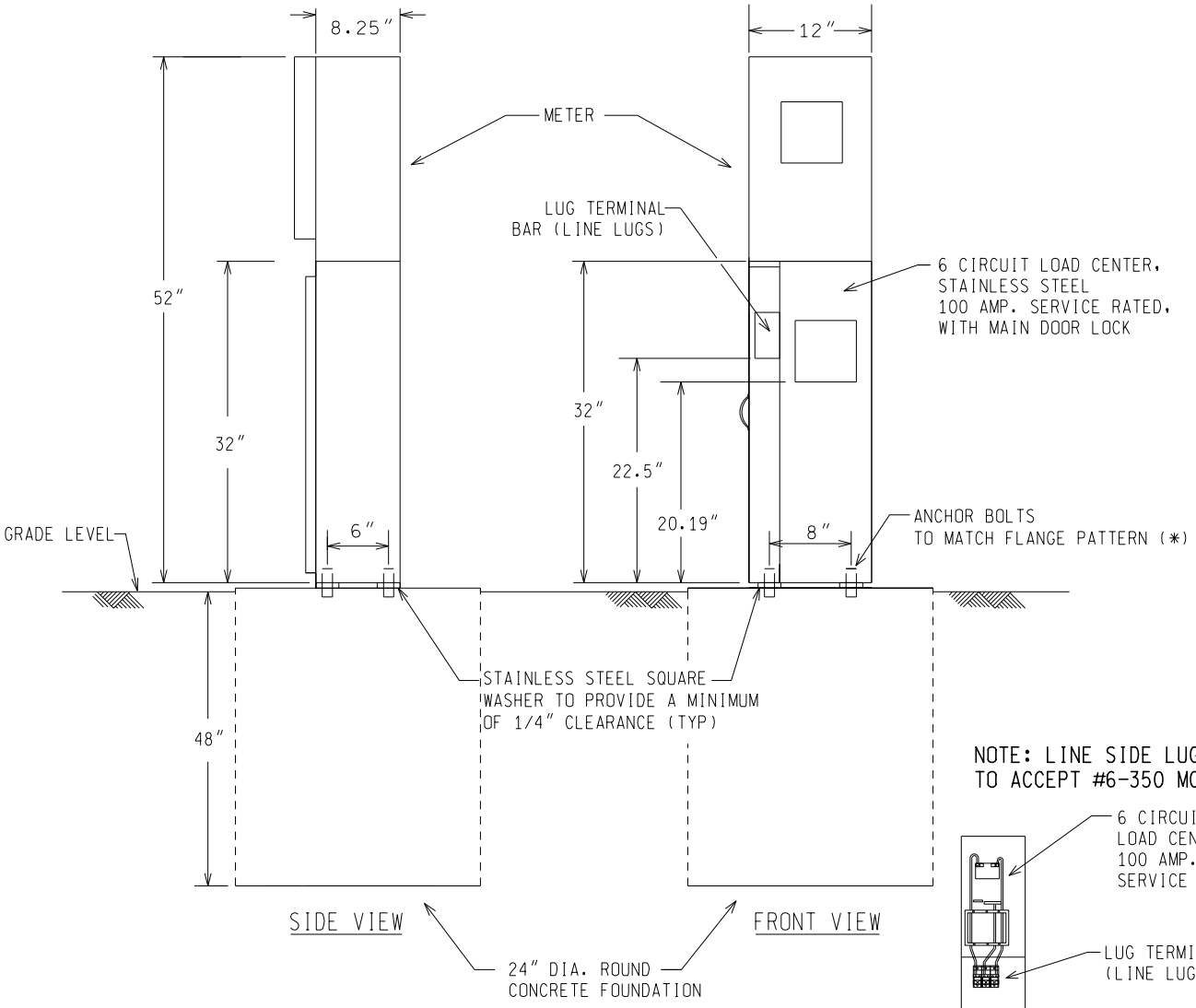
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

UNDERGROUND SERVICE METERED AND UNMETERED

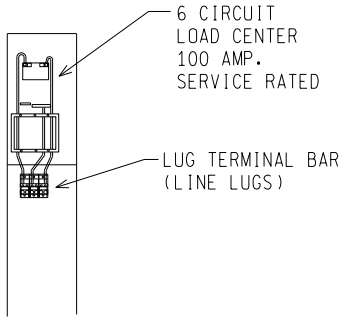
PLAN DATE

SIG-210-B

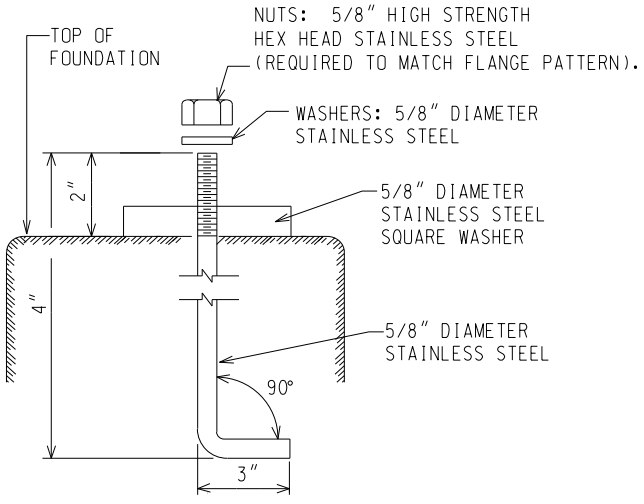
SHEET 1 of 3



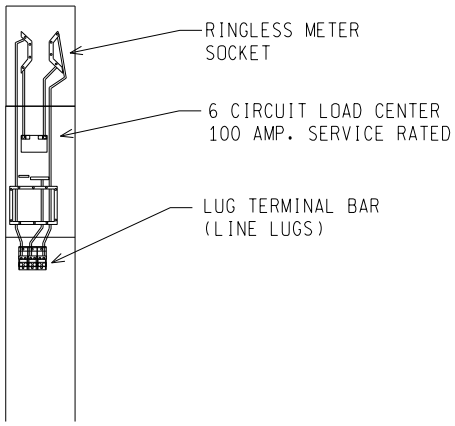
NOTE: LINE SIDE LUGS TO ACCEPT #6-350 MCM AWG



DETAIL WIRING DIAGRAM
(UNMETERED)



ANCHOR BOLT DETAIL

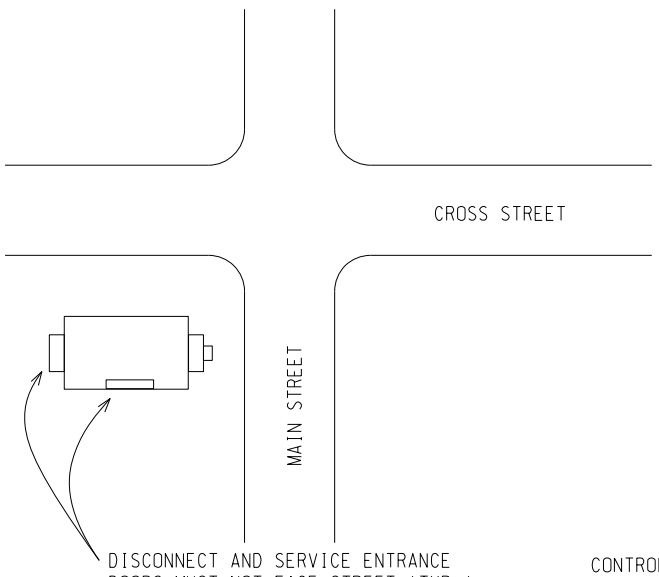


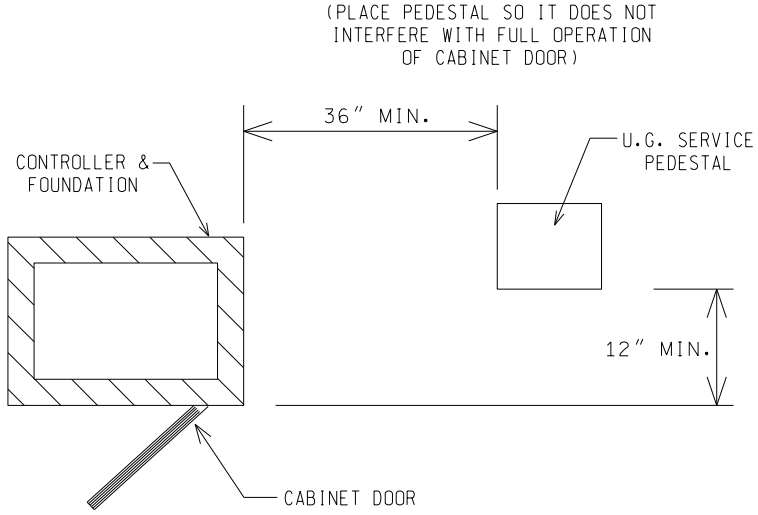
DETAIL WIRING DIAGRAM
(METERED)

NOT TO SCALE

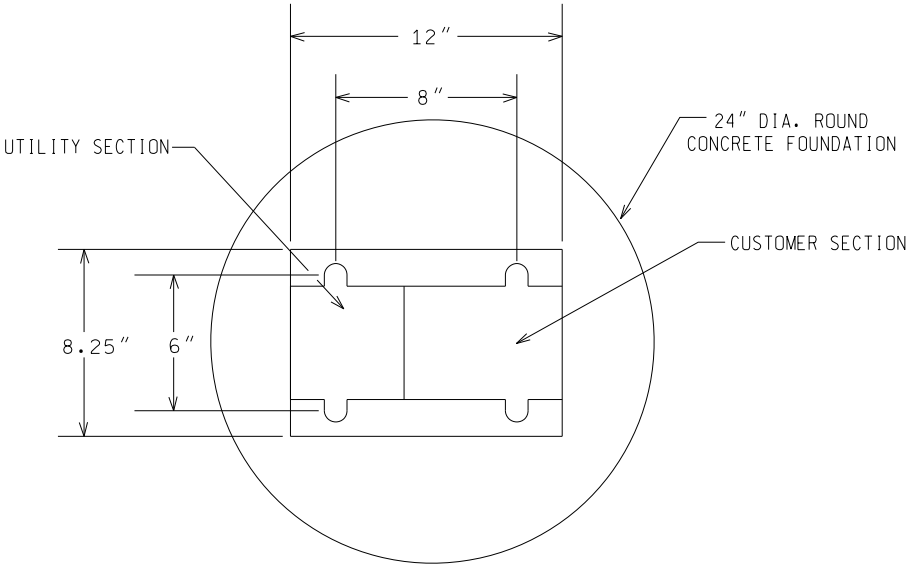
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-210-B	SHEET 2 of 3
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG210B.dgn Rev. 02/06/18		PLAN DATE		

PREFERRED SITE ORIENTATION PLAN





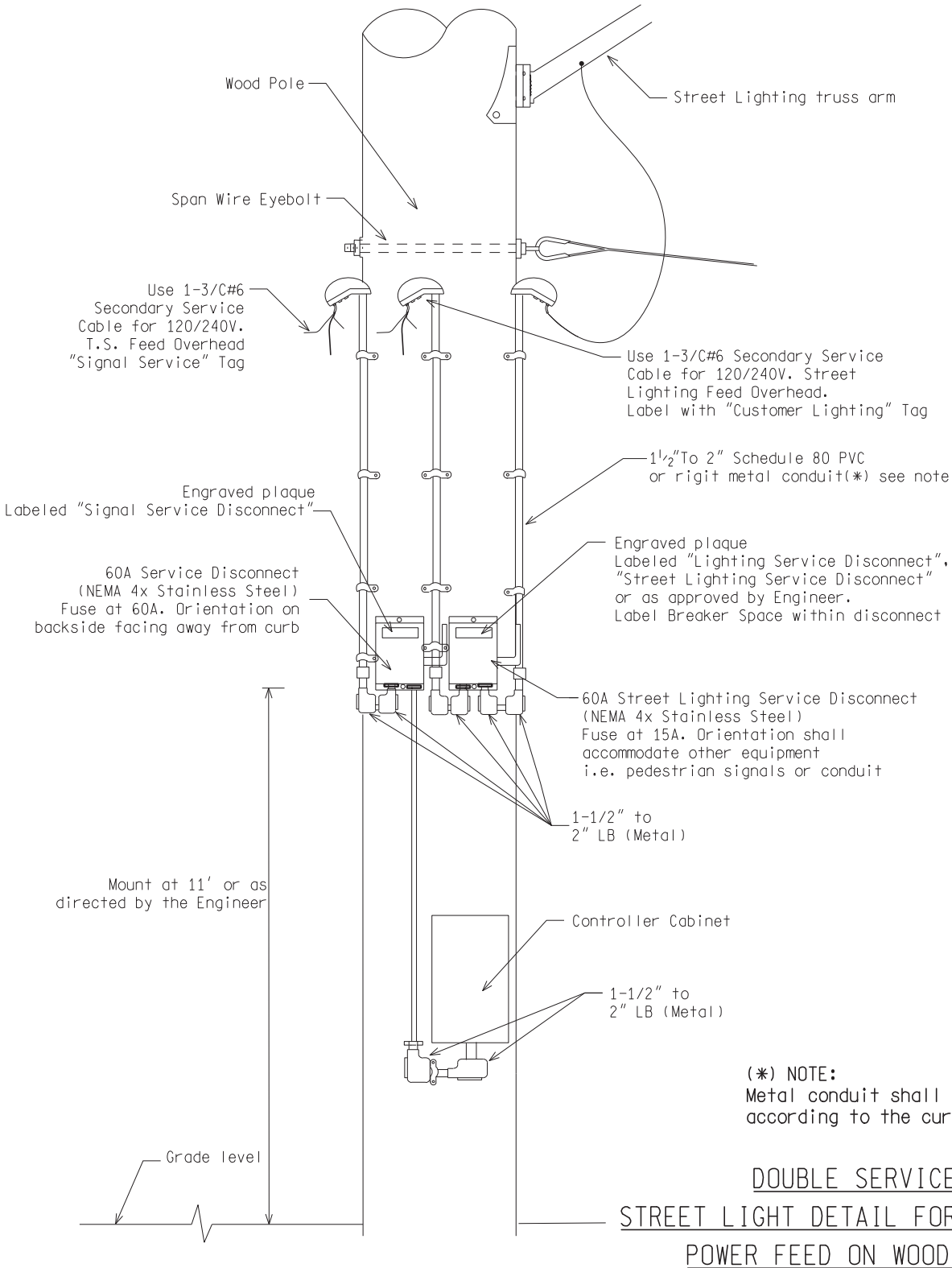
PREFERRED PEDESTAL & FOUNDATION ORIENTATION PLAN



BOLT PATTERN LAYOUT

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-210-B	SHEET 3 of 3
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG210B.dgn Rev. 02/06/18		PLAN DATE		



(*) NOTE:
Metal conduit shall be bonded according to the current N.E.C.

DOUBLE SERVICE STREET LIGHT DETAIL FOR OVERHEAD POWER FEED ON WOOD POLE

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG220A.dgn Rev.

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DSP

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

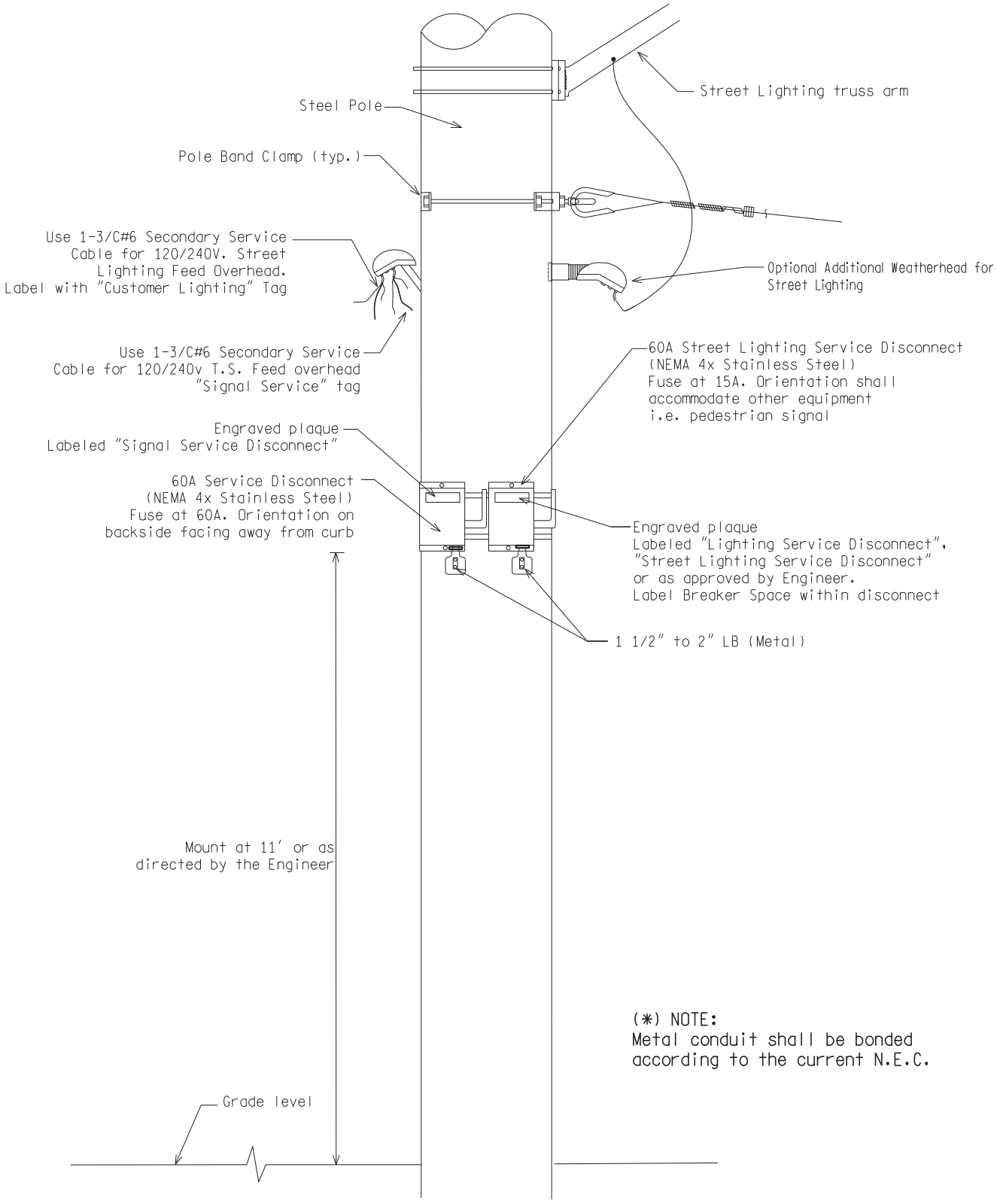
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

SECONDARY SERVICE FOR STREET LIGHTING AND STREET NAME SIGNS

02/16/17
PLAN DATE

SIG-220-A

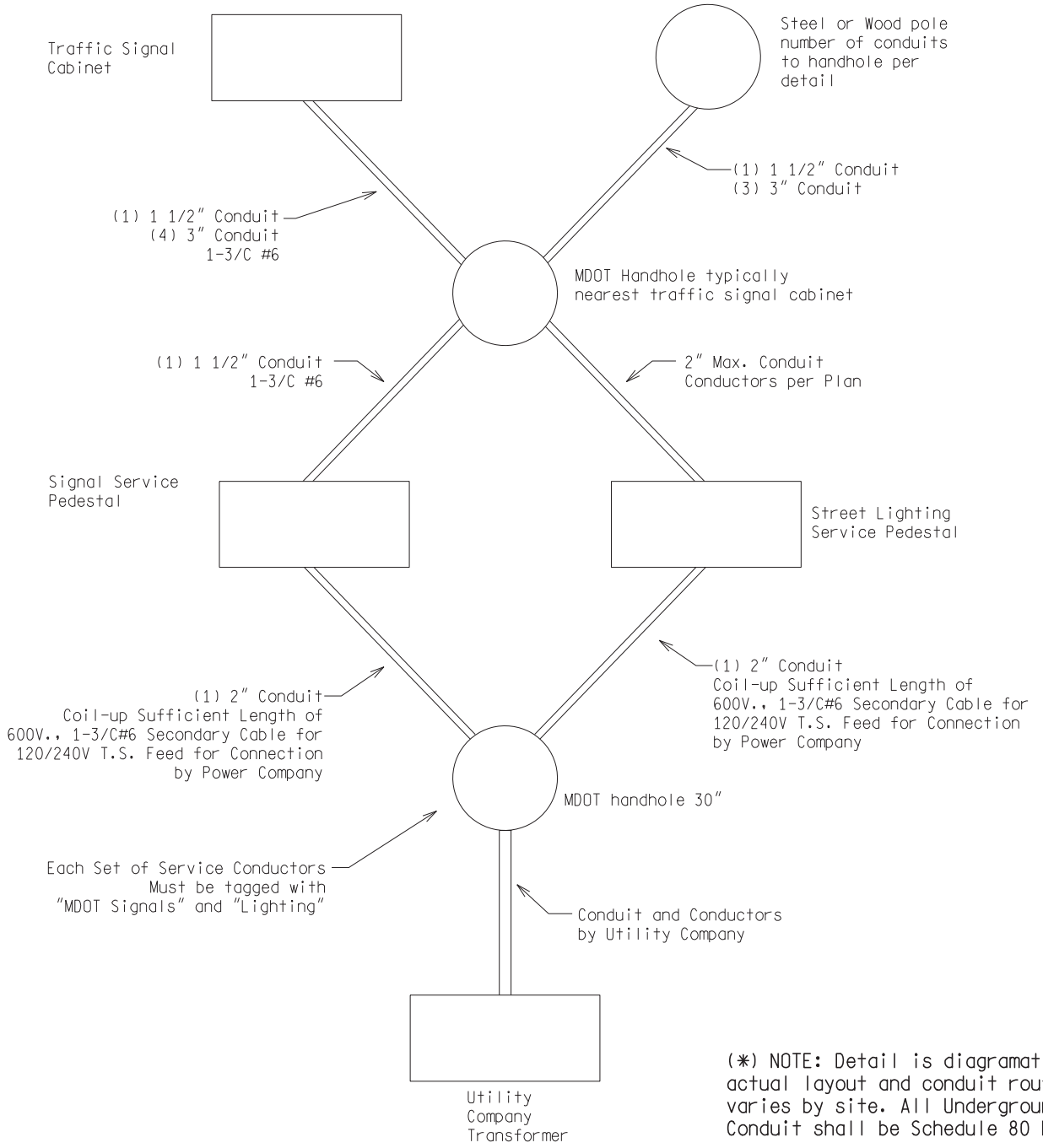
SHEET
1 of 4



DOUBLE SERVICE
STREET LIGHT DETAIL FOR OVERHEAD
POWER FEED ON STEEL POLE

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	02/16/17 PLAN DATE	SIG-220-A	SHEET 2 of 4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG220A.dgn Rev.				

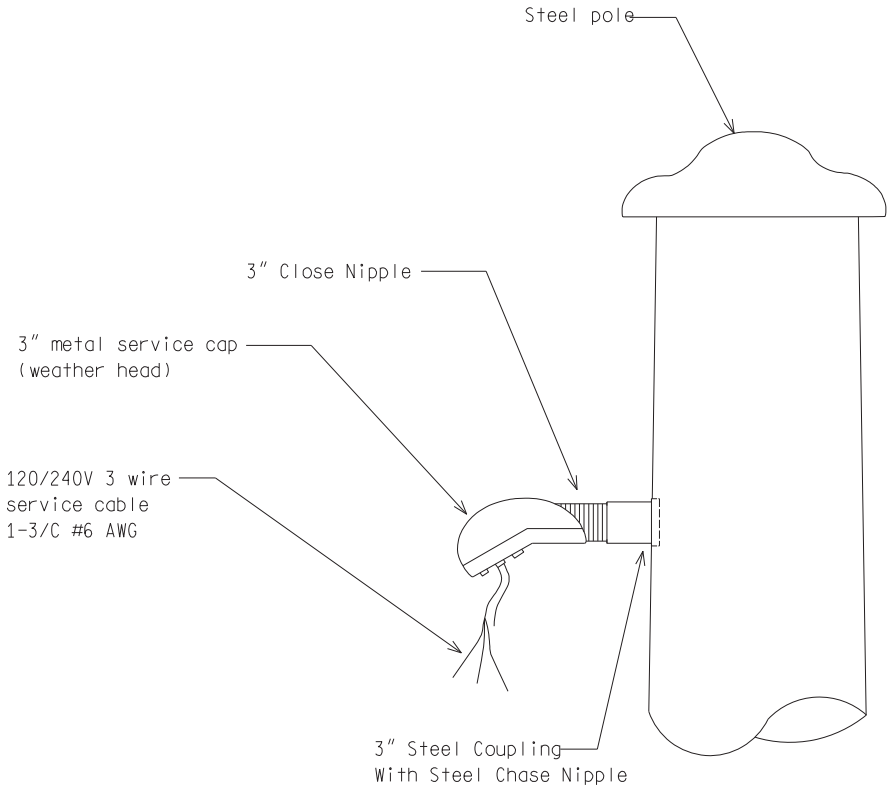


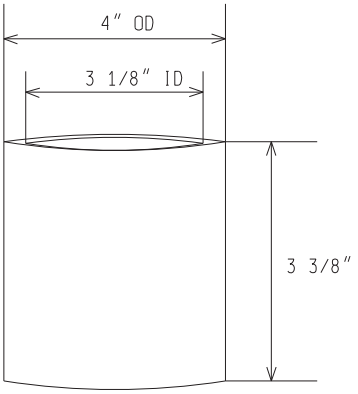
(*) NOTE: Detail is diagramatic only. actual layout and conduit routing varies by site. All Underground Conduit shall be Schedule 80 PVC.

UNDERGROUND DOUBLE SERVICE STREET LIGHTING WIRING DIAGRAM

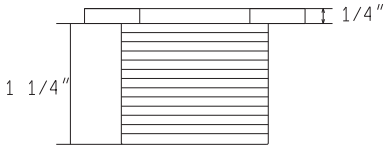
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	02/16/17 PLAN DATE	SIG-220-A	SHEET 3 of 4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG220A.dgn Rev.				

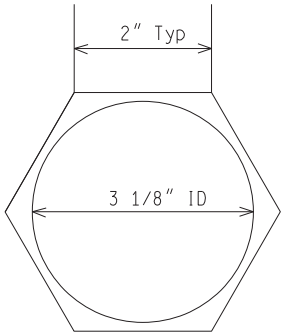




Steel Coupling



Chase Nipple A

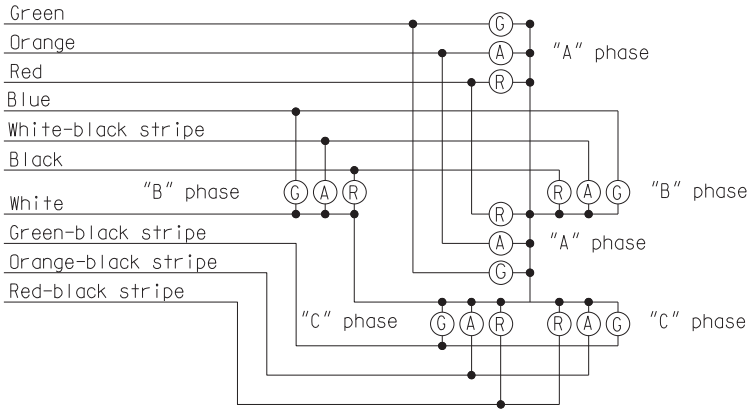


Chase Nipple B

STRAIN POLE WEATHER HEAD INSTALLATION

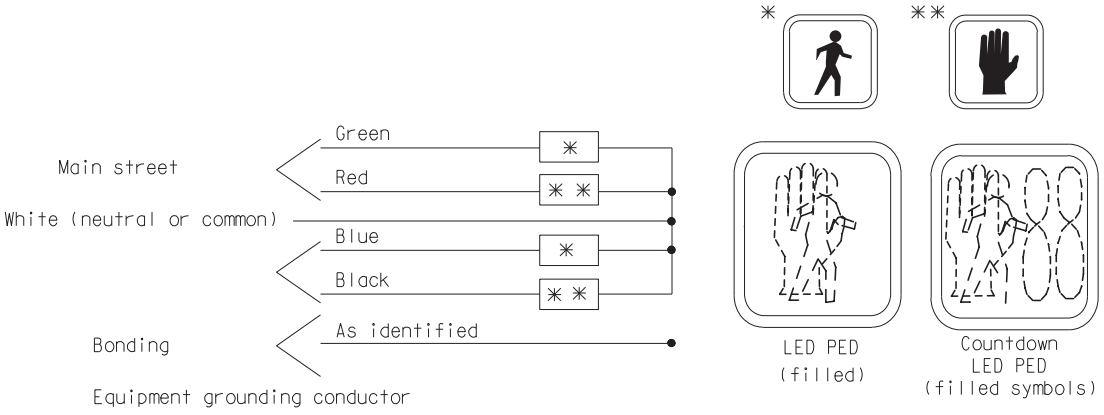
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	02/16/17 PLAN DATE	SIG-220-A	SHEET 4 of 4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG220A.dgn Rev.				



COLOR CODE FOR WIRING CONNECTING TRAFFIC SIGNAL LAMPS

NOTE:No splices allowed between traffic signal head and controller.



COLOR CODE FOR WIRING CONNECTING PEDESTRIAN SIGNAL LAMPS
(WALKING PERSON - HAND SYMBOL)

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

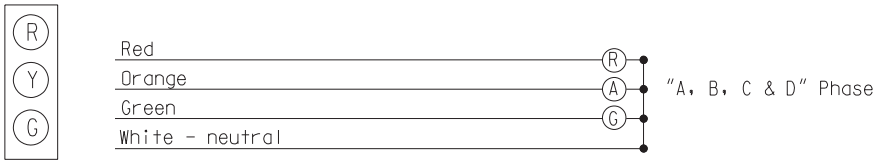
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

COLOR CODE WIRING/ EQUIPMENT GROUNDING

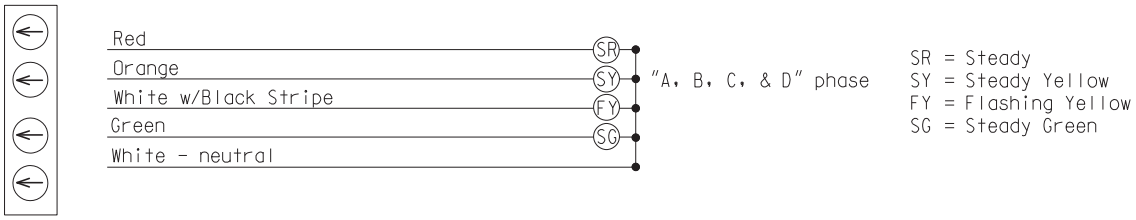
PLAN DATE

SIG-230-A

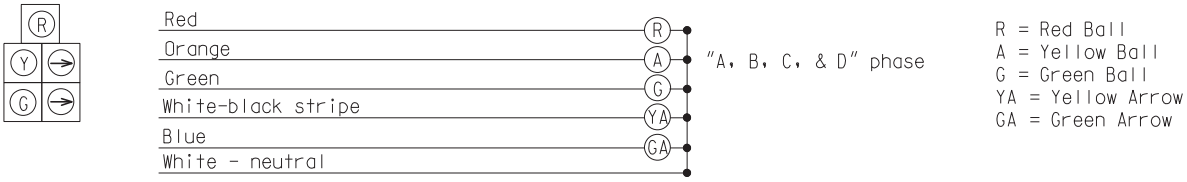
SHEET 1 of 6



STANDARD - 3 COLOR SIGNAL DISPLAY



FLASHING YELLOW ARROW (FYA) - 4 COLOR SIGNAL DISPLAY

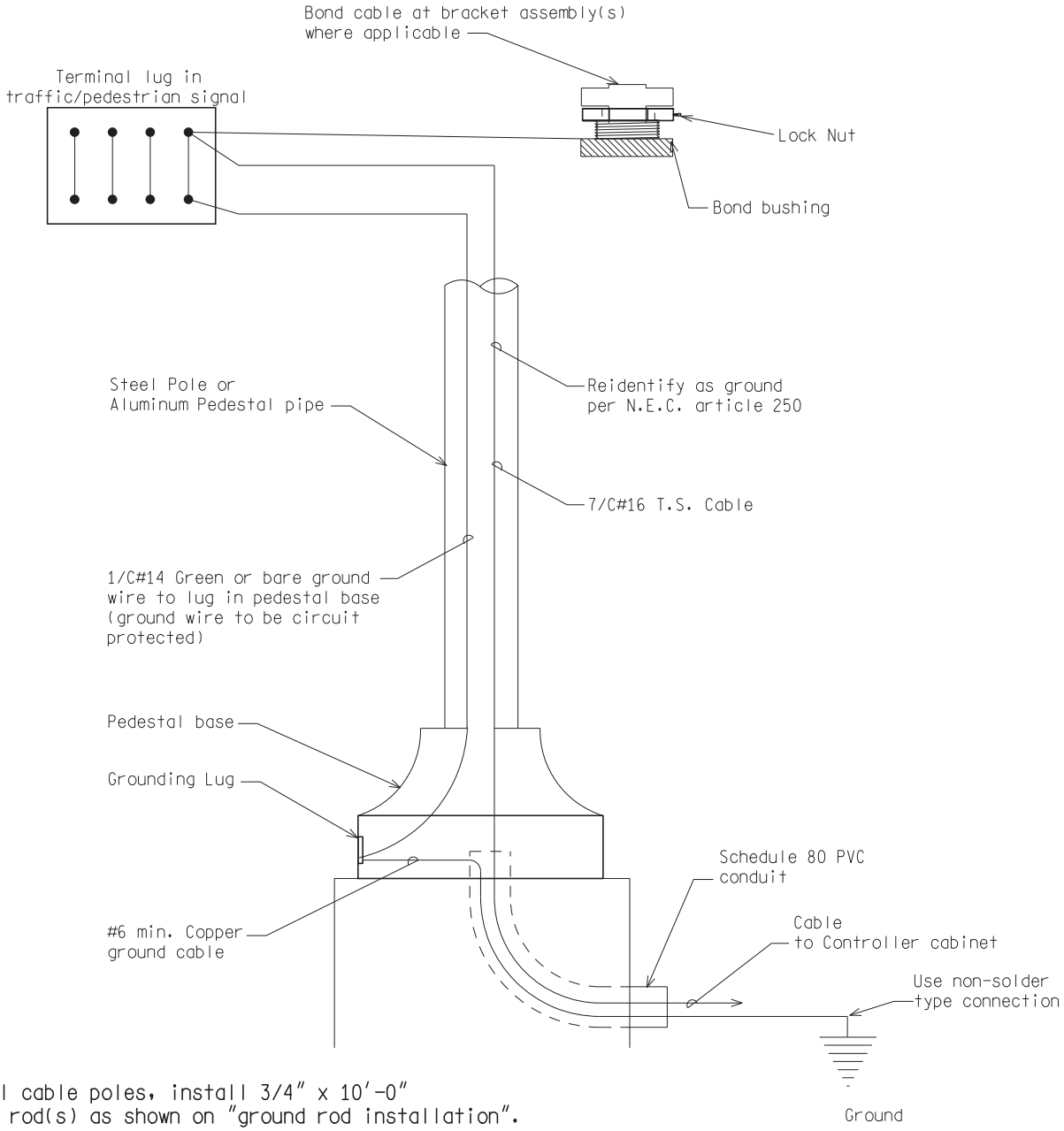


DOG HOUSE W/RIGHT TURNS - 5 COLOR SIGNAL DISPLAY

COLOR CODE FOR WIRING CONNECTING TRAFFIC SIGNAL LAMPS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-230-A	SHEET 2 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17		PLAN DATE		

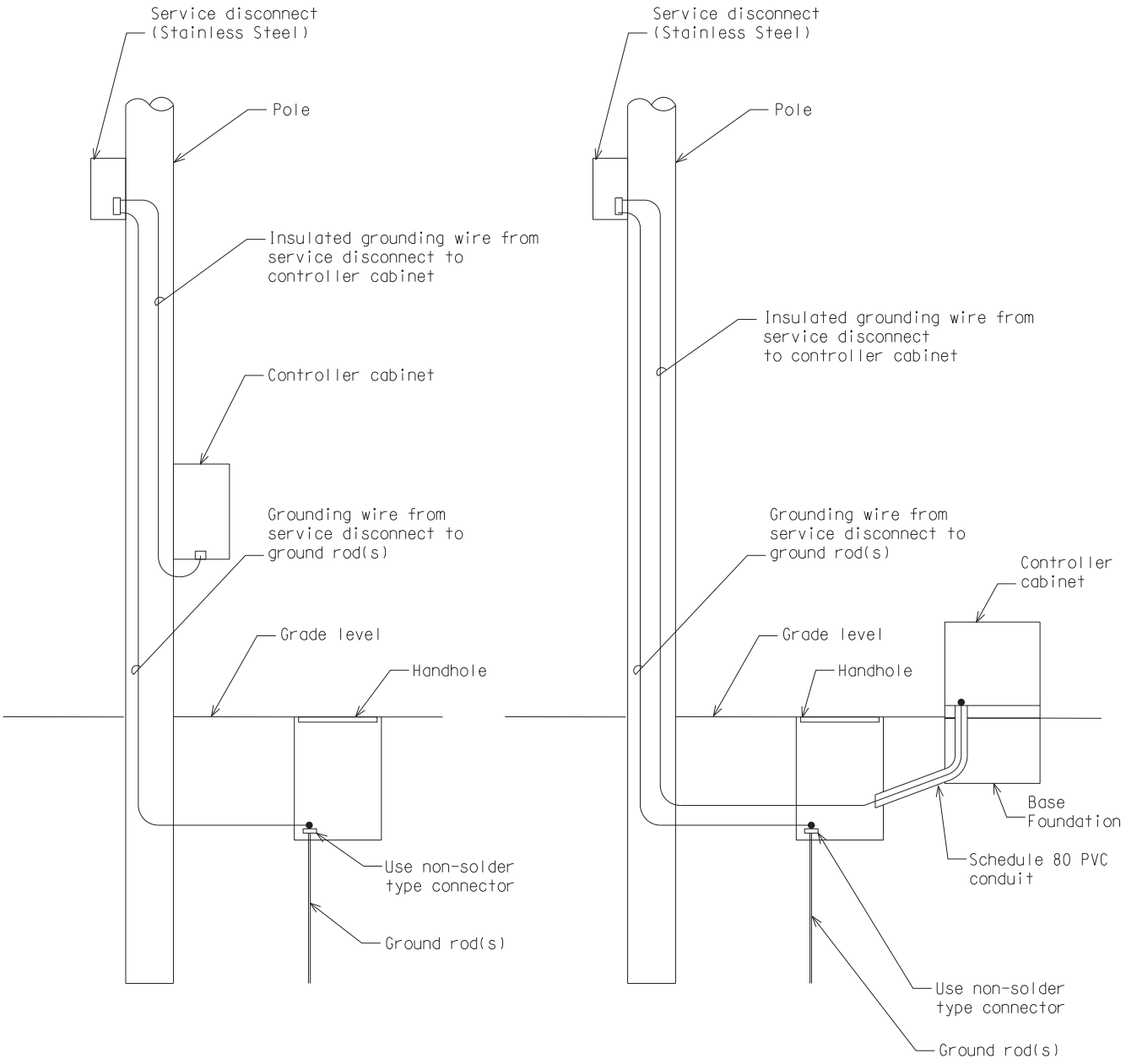


NOTE:
For all cable poles, install 3/4" x 10'-0"
ground rod(s) as shown on "ground rod installation".
Connect ground rod(s) with #6 min. copper wire to
messenger wire with non-solder type connection.

STEEL POLE/PEDESTAL GROUNDING DETAIL

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	PLAN DATE	SIG-230-A	SHEET 3 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17				



GROUNDING

Install 3/4 " x 10'-0" copper clad ground rod(s) as required to provide less than 10 OHM resistance to ground.

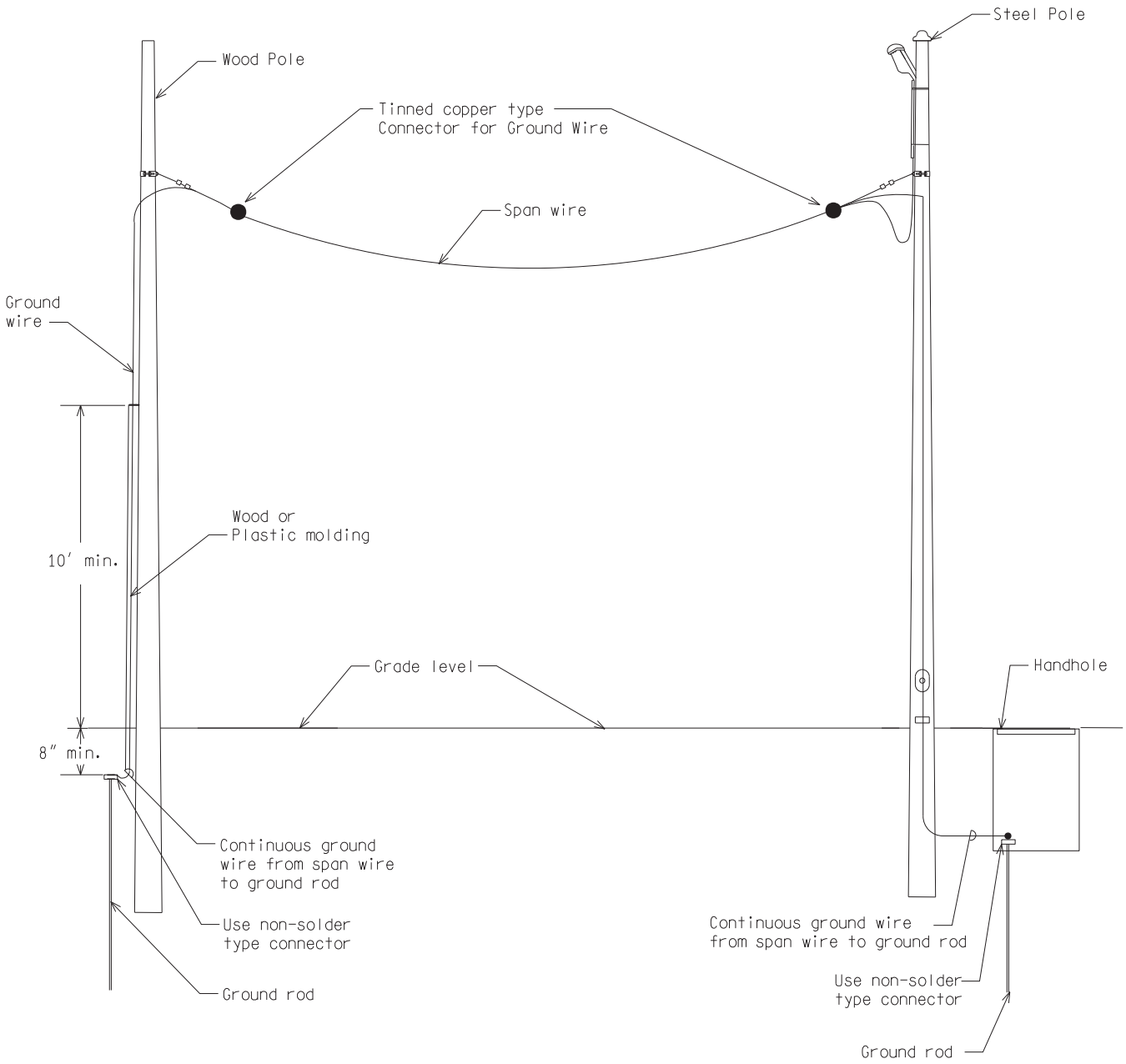
Grounding wire #6 AWG min. bare copper grounding wire shall be installed to meet N.E.C. and utility company specs.

Ground wire from disconnect to ground rod to be in moulding (wood pole or post) or inside the pole (steel). Ground wire from disconnect to controller cabinet to be in conduit (wood pole, wood post, and steel pole).

CONTROLLER CABINET GROUNDING DETAIL

NOT TO SCALE

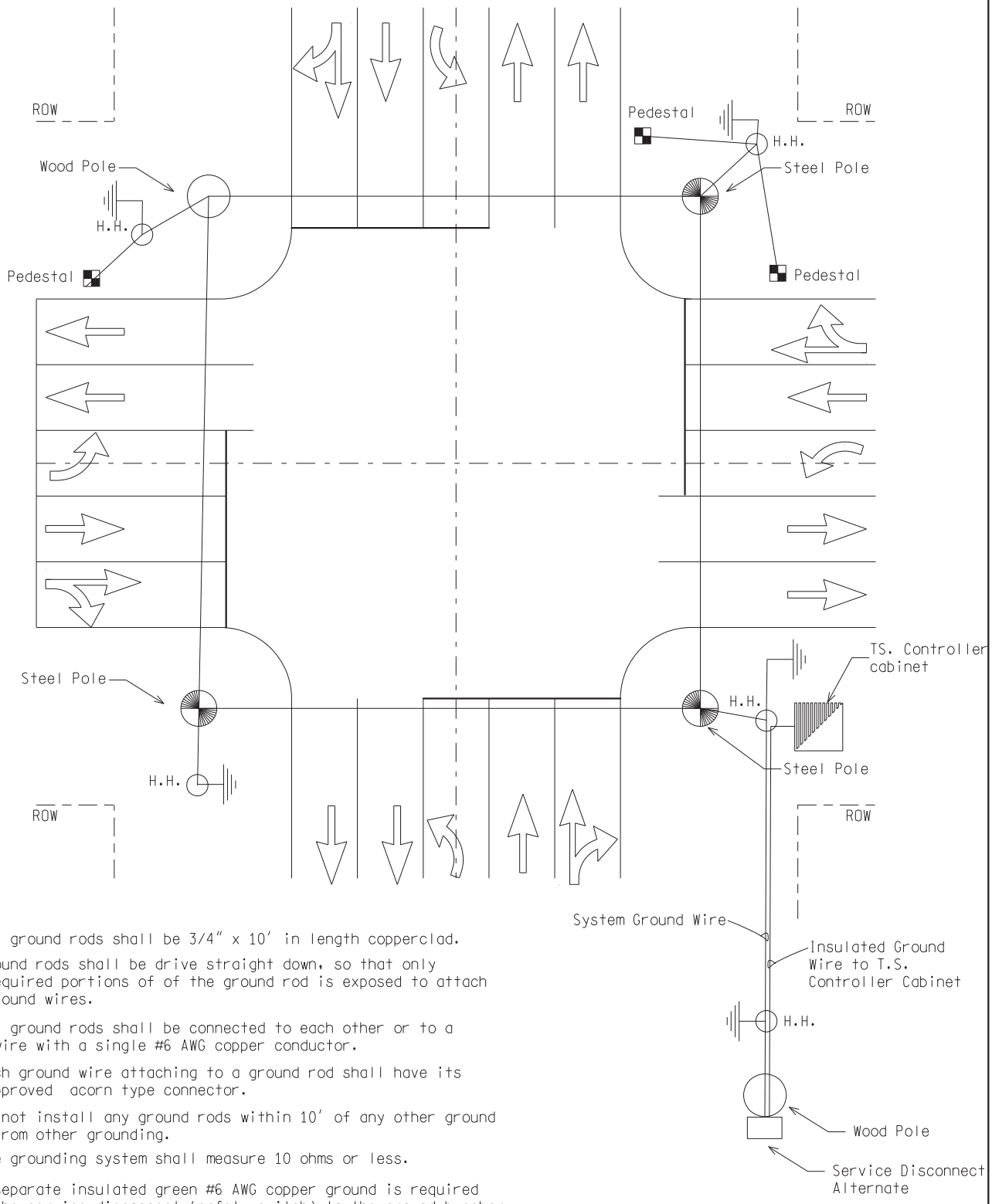
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17		PLAN DATE	SIG-230-A	SHEET 4 of 6



SPAN WIRE GROUNDING DETAIL

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17		PLAN DATE	SIG-230-A	SHEET 5 of 6



1) All ground rods shall be 3/4" x 10' in length copperclad.

2) Ground rods shall be drive straight down, so that only the required portions of of the ground rod is exposed to attach the ground wires.

3) All ground rods shall be connected to each other or to a span wire with a single #6 AWG copper conductor.

4) Each ground wire attaching to a ground rod shall have its own approved acorn type connector.

5) Do not install any ground rods within 10' of any other ground rods from other grounding.

6) The grounding system shall measure 10 ohms or less.

7) A separate insulated green #6 AWG copper ground is required from the service disconnect (safety switch) to the ground bussbar in the controller cabinet.

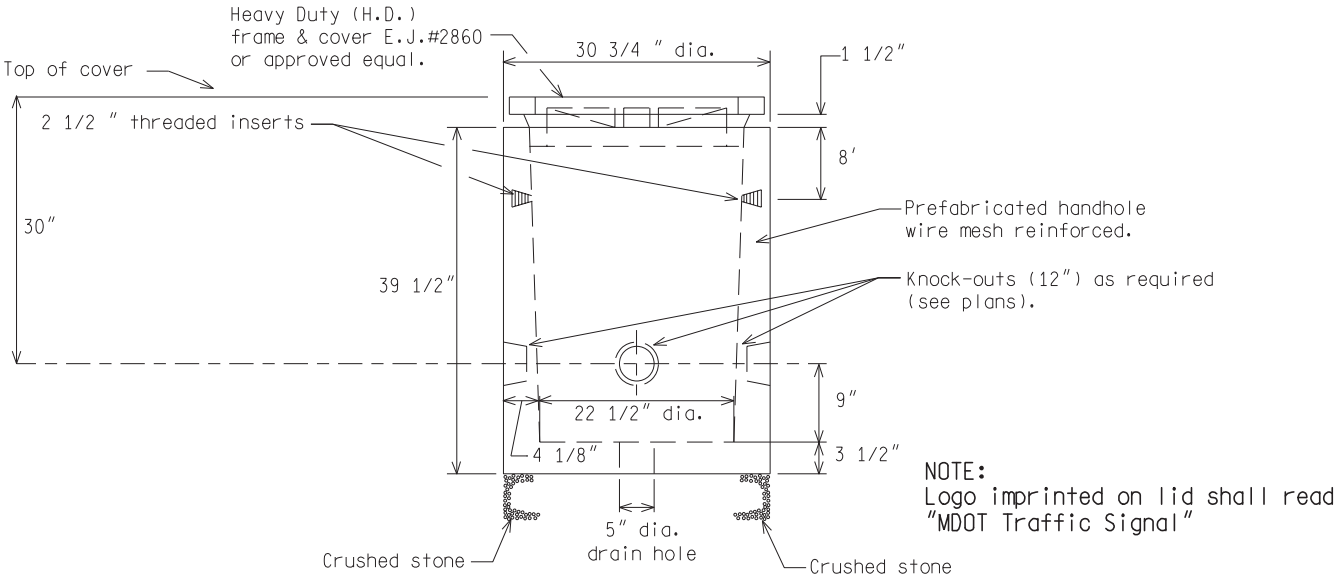
8) Ground rod for each steel pole, wood pole, pedestal and/or traffic signal controller cabinet shall be located in the adjacent handhole as indicated on the plans or as directed by the Engineer.

9) All metal bases must be connected to a ground rod with a #6 ground wire.

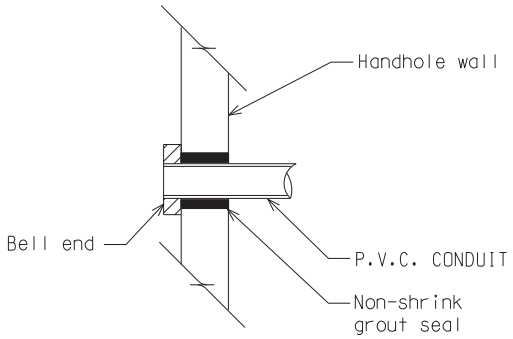
SYSTEM GROUNDING DETAL

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG230A.dgn Rev. 02/16/17		PLAN DATE	SIG-230-A	SHEET 6 of 6



2' PRECAST ROUND HANDHOLE WITH FLOOR



TYPICAL CONDUIT ENTRANCE
AT HANDHOLE

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG240A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

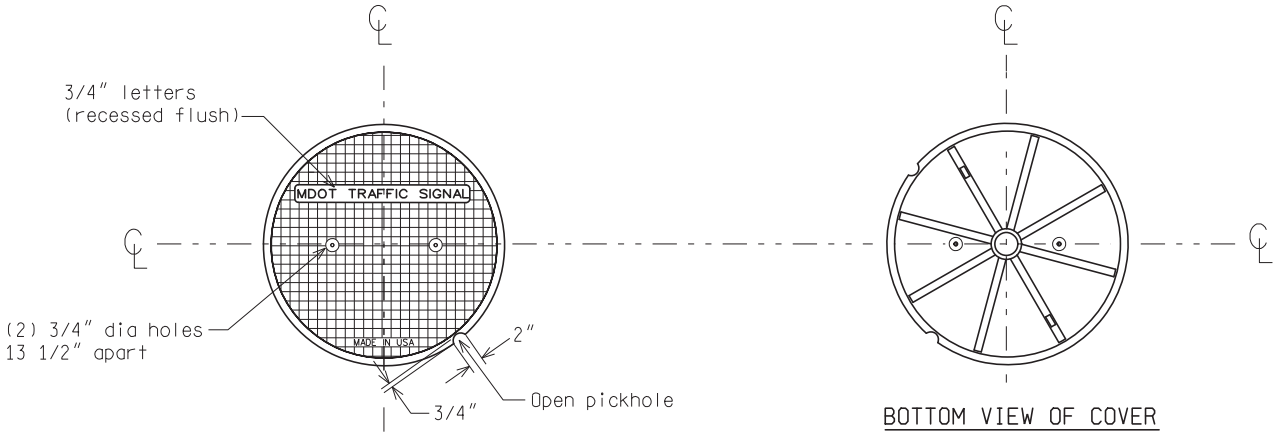
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

HANDHOLE- PRECAST, POLYMER CONCRETE

PLAN DATE

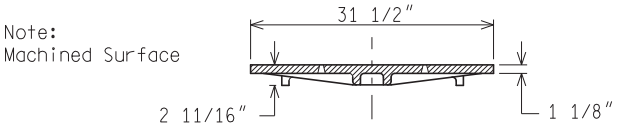
SIG-240-A

SHEET
1 of 6

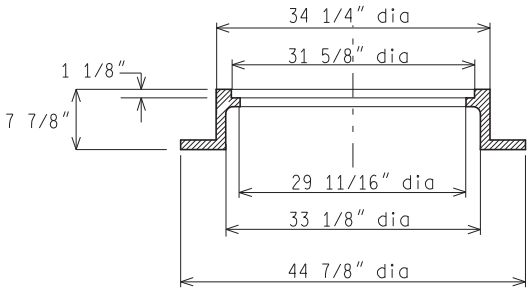


TOP VIEW OF COVER

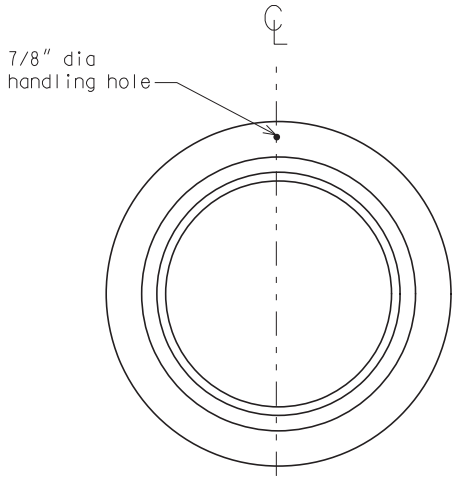
BOTTOM VIEW OF COVER



COVER SECTION



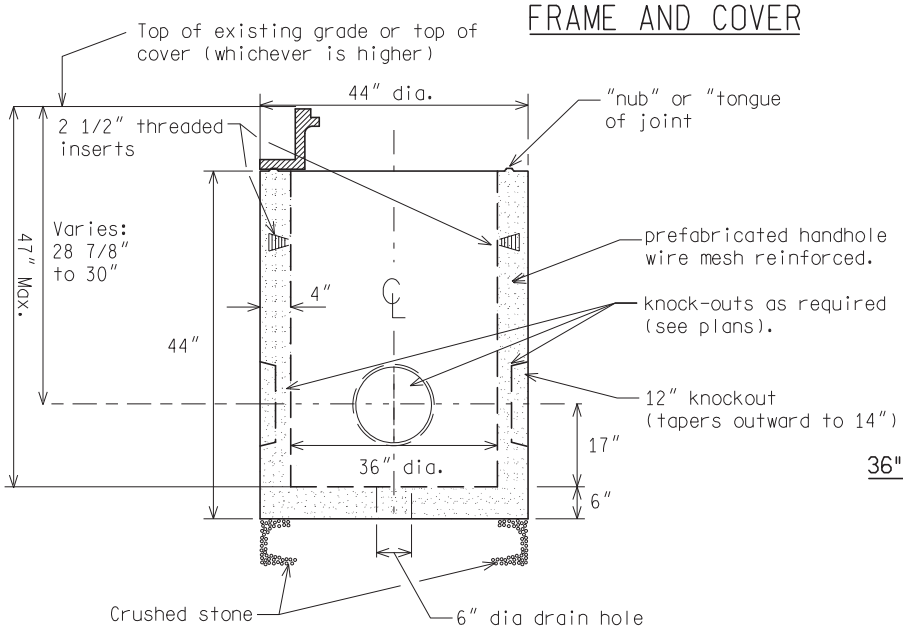
FRAME SECTION



TOP VIEW OF FRAME

The H. D. frame and cover shall be manufactured by East Jordan Iron Works, Model 1220 or approved equal.

FRAME AND COVER



3' DIAMETER ROUND PRECAST CONCRETE HANDHOLE

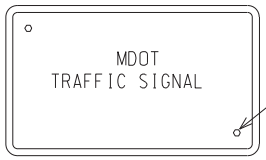
NOTE:
Logo imprint may read "Traffic Signal" for non MDOT Installation

36" PRECAST ROUND HANDHOLE SECTION DETAIL

NOT TO SCALE

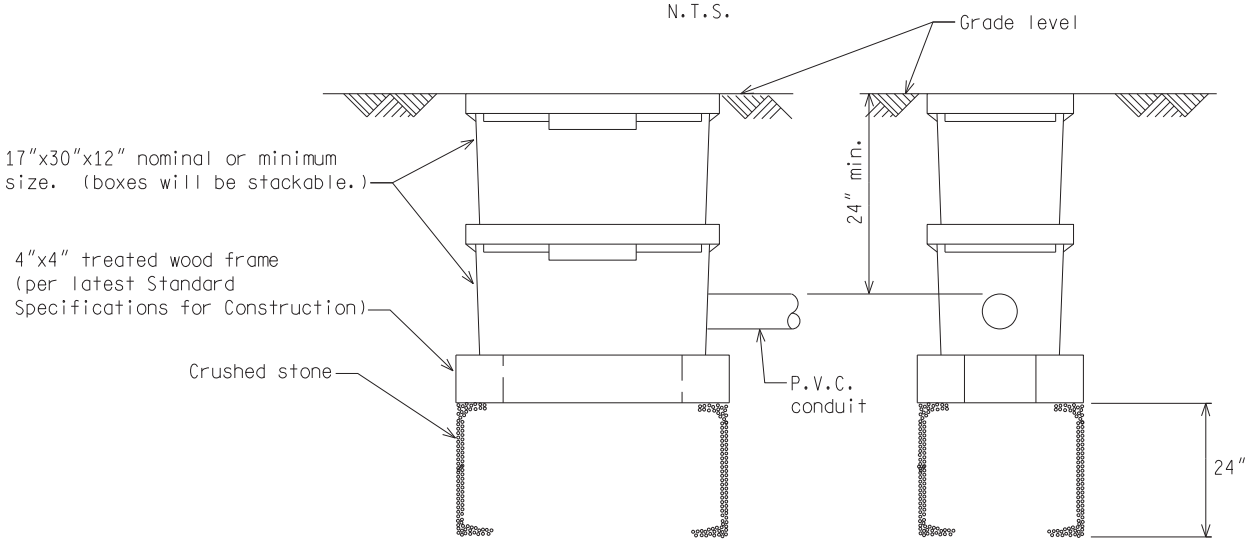
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-240-A	SHEET 2 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG240A.dgn Rev. 02/16/17		PLAN DATE		

NOTE:
Logo imprint may read "Traffic Signal" for non MDOT installations



3/8 "-16NC stainless steel Hex bolt & washer

COVER
N.T.S.



POLYMER CONCRETE HANDHOLE

NOTES PERTAIN TO PRECAST OR BRICK:

1) The material and workmanship shall be in accordance with the current M.D.O.T. Standard Specifications for Construction.

2) All concrete masonary shall be grade 30M.

3) The inner surface of the handhole shall be smooth.

4) Heavy Duty covers shall be castings which meet the requirements of the current specifications for gray iron castings ASTM designation A48 and shall have a minimum strength as provided for Class No. 30 gray iron castings.

5) All castings shall be cleaned by sand blasting.

6) The seating face of the cover and the seat for the same on the frame if required, shall be ground or machined so that the cover shall have an even bearing on its seat to prevent rocking or tilting.

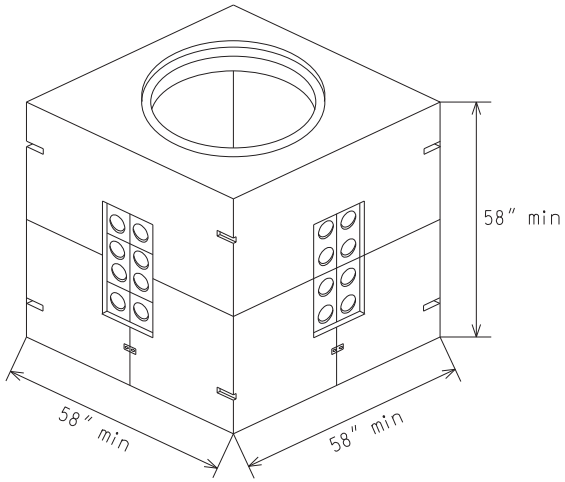
7) The castings shall be free of pouring faults, blow holes, cracks,and other imperfections. They shall be sound, true to form and thickness, clean and neatly finished and shall be coated with tar pitch varnish.

8) Light Duty cover shall be bolted to frame with not less than 2 countersunk Hex head bronze bolts.

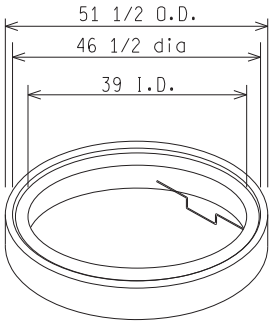
9) The Heavy Duty cover & frame shall be East Jordan Iron Works #8206 Neenah Foundry, #R-6662-HP for square cover or East Jordan Iron Works #2860 Type "A", Neenah Foundry #R-6052 D for circular cover or an approved equal.

10) Handhole shall be equipped with cable rack and hooks to train cable.

NOT TO SCALE



NOTE:
Galvanized step is standard with grade ring ASTM C478.



Dimensions	
A	Min Wt. (lbs)
6	440
9	650
12	860

	Length	Width	Height
Inside	48	48	48
Outside	58	58	58
Recommended Hole size	82	82	--

GRADE RING WITH 39" I.D. & 46 1/2" RECESS

	Min Thickness
Wall	5
Roof	5
Floor	5

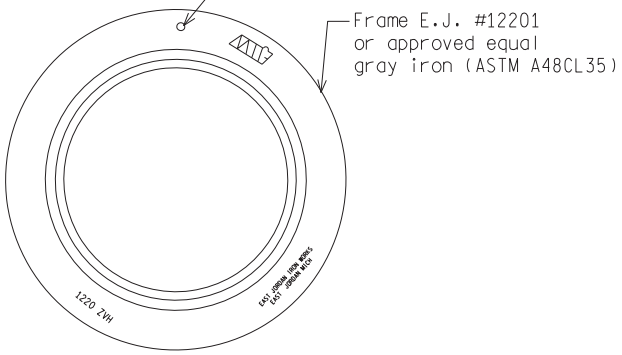
	Min Weight lbs
Top	3300
Bottom	3850
Total	7150

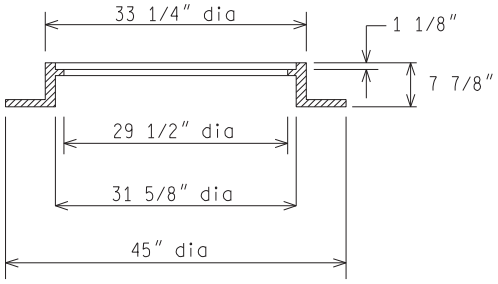
4' x 4' x 4' PRECAST CONCRETE HANDHOLE

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-240-A	SHEET 4 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG240A.dgn Rev. 02/16/17		PLAN DATE		

NOTE:
Logo imprint it on cover shall read "MDOT Traffic Signal" for MDOT installations



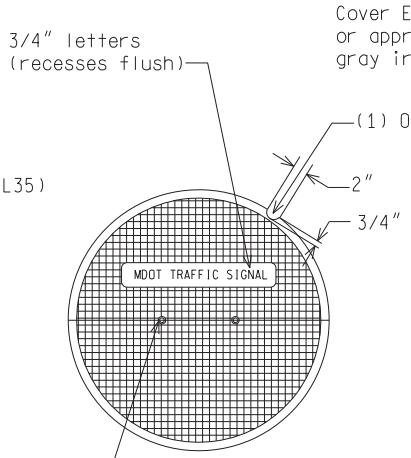


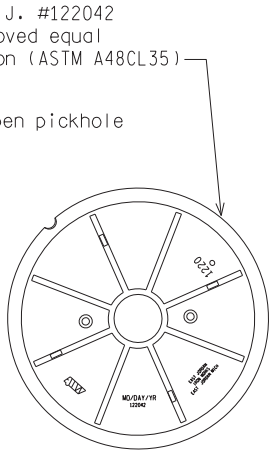
FRAME SECTION

MANHOLE FRAME (HEAVY DUTY)

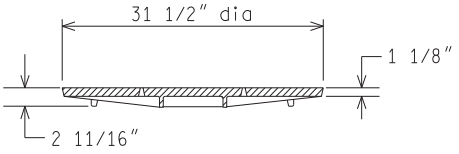
Estimated weight 410 lbs

NOTE:
Machined surface





BOTTOM VIEW OF COVER



COVER SECTION

NOTE:
Machined surface

MANHOLE COVER (HEAVY DUTY)

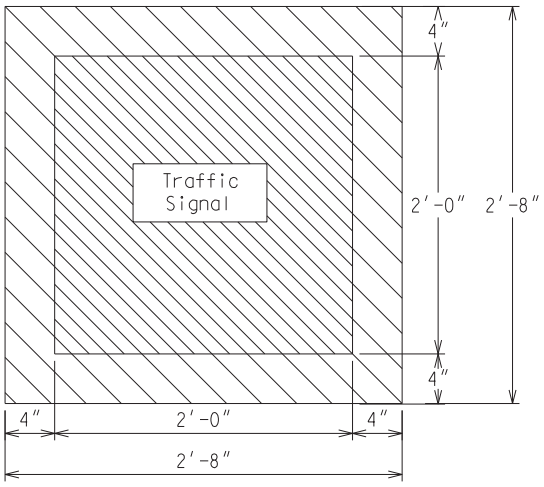
Estimated weight 245 lbs

4' x 4' x 4' PRECAST CONCRETE HANDHOLE

NOT TO SCALE

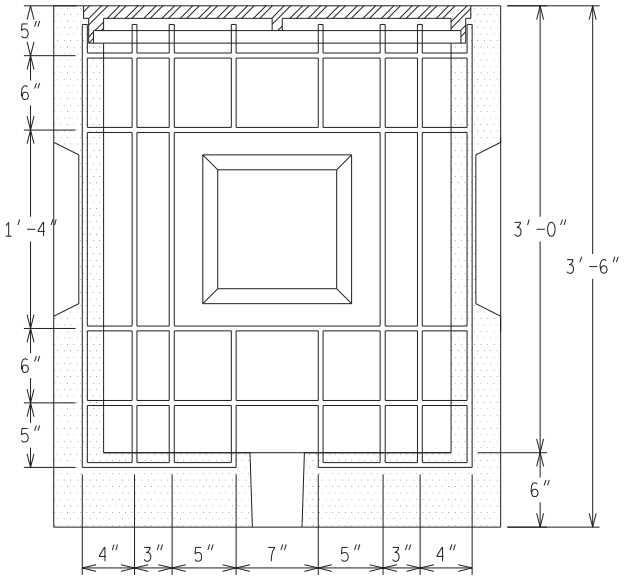
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG240A.dgn Rev. 02/16/17		PLAN DATE	SIG-240-A	SHEET 5 of 6

Concrete: 4500 p.s.i. @ 28 days
Reinforcement: Grade 60 rebar
All bars are #4



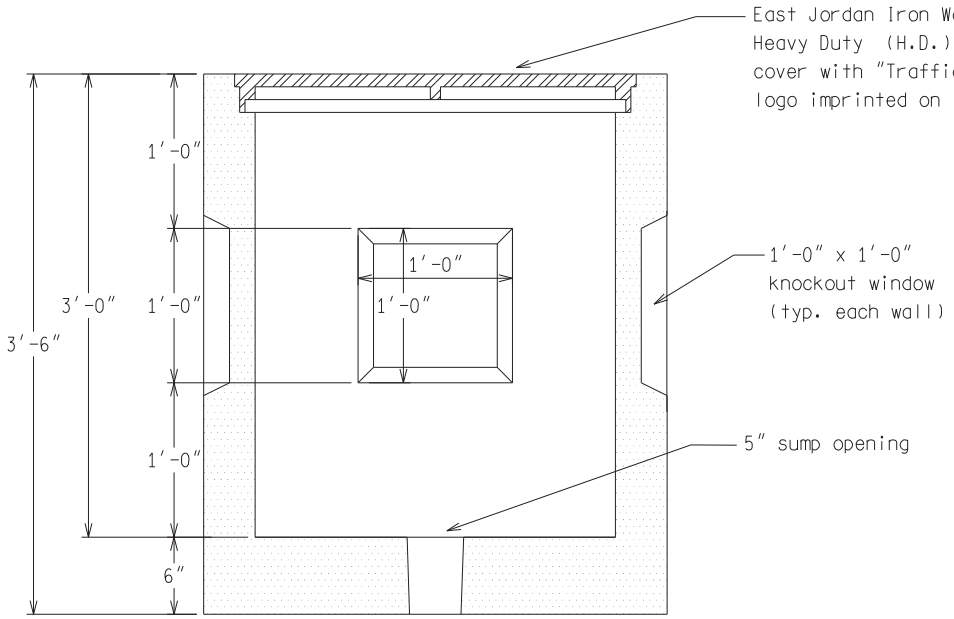
PLAN VIEW

With out frame & cover



SECTION VIEW

Typ. reinforcement all walls



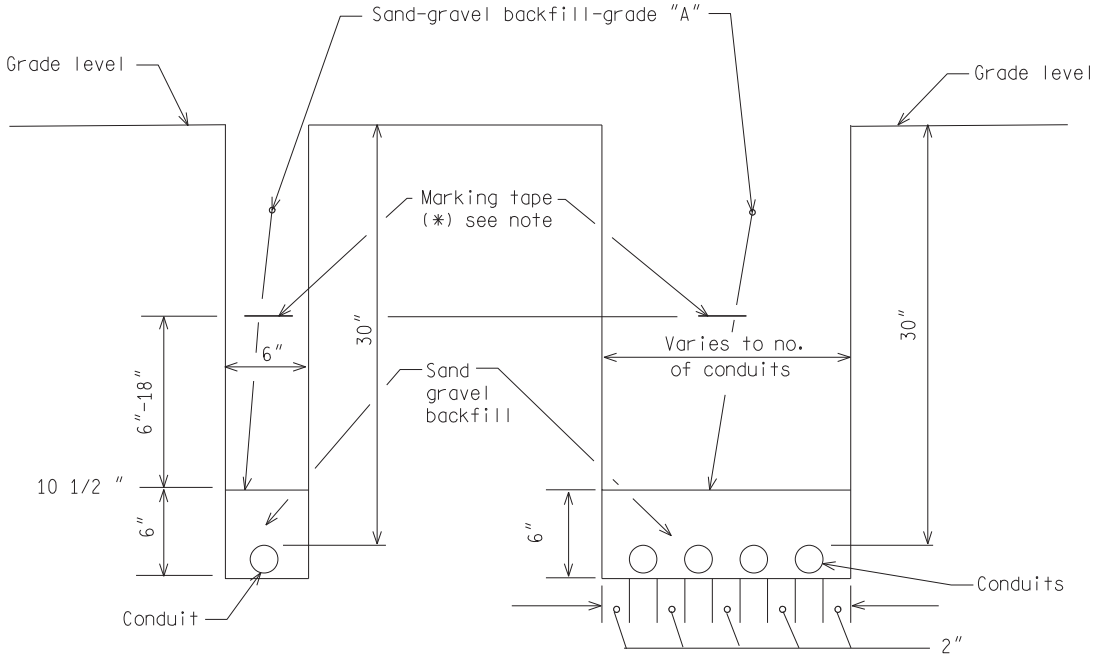
SECTION VIEW

2' x 2' SQUARE x 3' HANDHOLE

For use on Oakland County roads only.

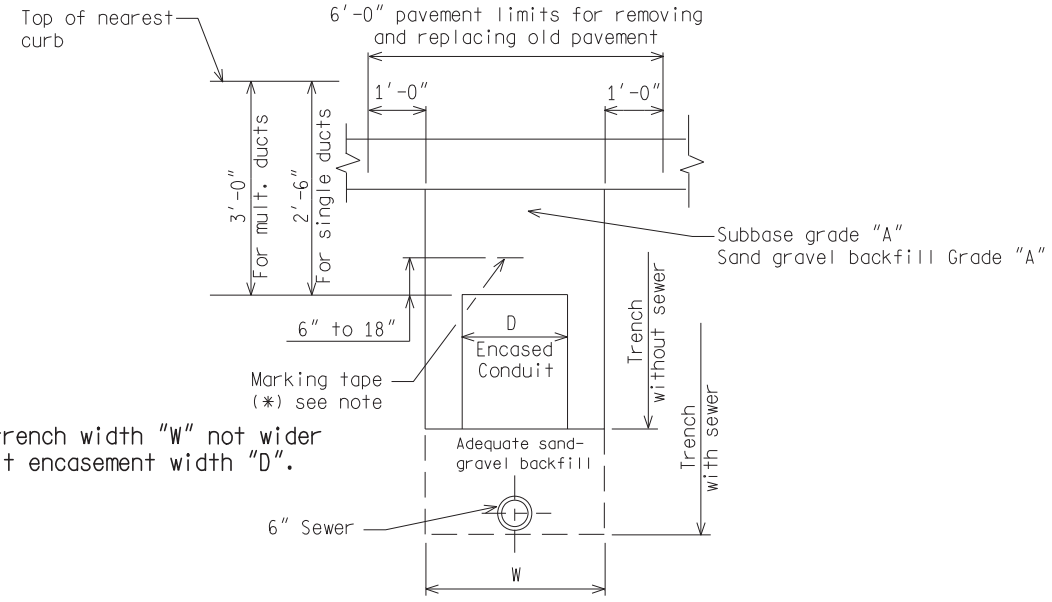
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	PLAN DATE	SIG-240-A	SHEET 6 of 6
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG240A.dgn Rev. 02/16/17				



(*) NOTE:
Marking tape shall have proper logo as supplied by the Engineer and installed by the Contractor.

DIRECT BURIAL CONDUIT(S)/CABLE(S)



NOTE:
Preferred trench width "W" not wider than conduit encasement width "D".

TYPICAL SECTION OF TRENCH
ENCASED CONDUIT

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG250A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

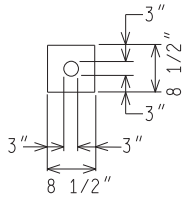
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

CONDUIT
(DIRECT BURIAL/ENCASED)

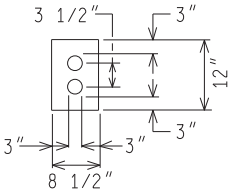
PLAN DATE

SIG-250-A

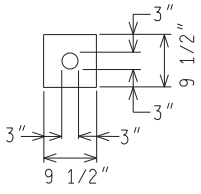
SHEET
1 of 2



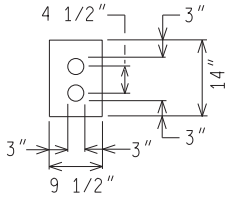
1 2″ CONDUIT



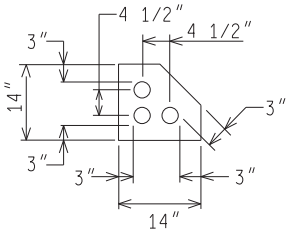
2 2″ CONDUIT



ONE
2 1/2″ CONDUIT



TWO
2 1/2″ CONDUIT



THREE
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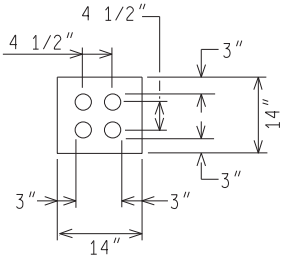
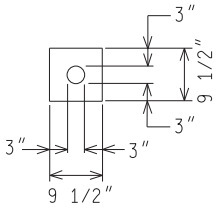
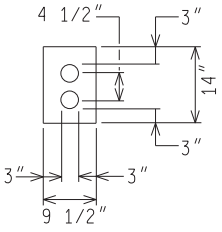


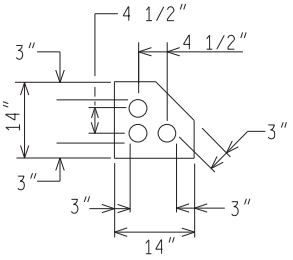
FOUR
2 1/2″ CONDUIT



1 3″ CONDUIT



2 3″ CONDUIT



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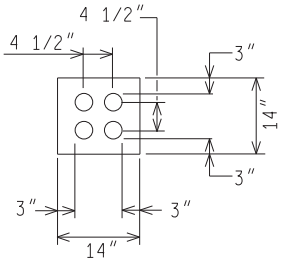

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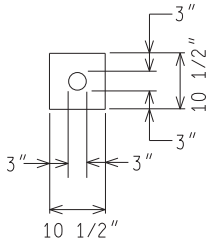
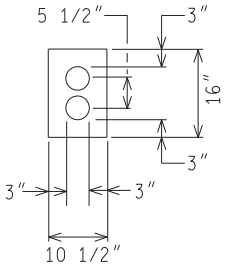


1 4″ CONDUIT



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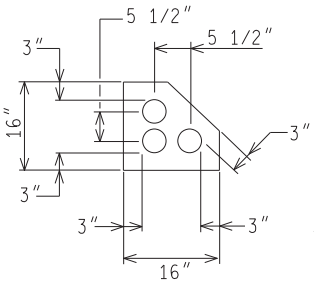
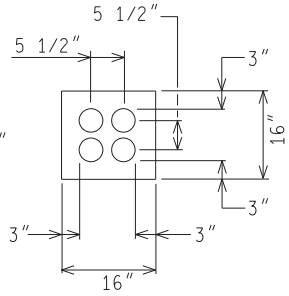


3 4″ CONDUIT

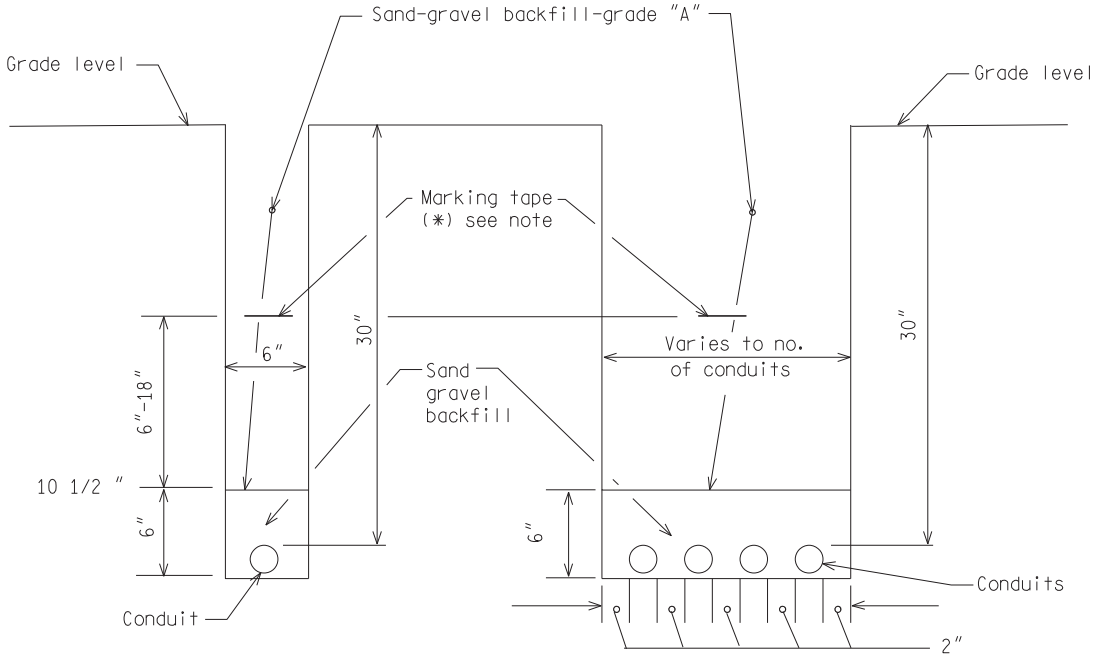


4 4″ CONDUIT

ENCASED CONDUIT SECTIONS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-250-A	SHEET 2 of 2
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG250A.dgn Rev. 02/16/17		PLAN DATE		



(*) NOTE:
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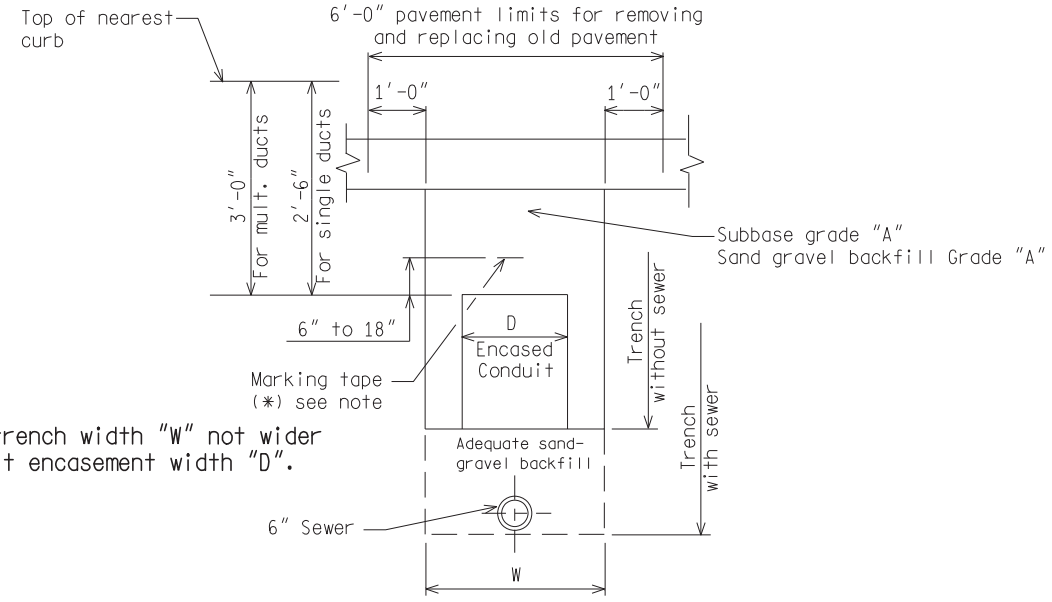
DIRECT BURIAL CONDUIT(S)/CABLE(S)



NOTE:
Preferred trench width "W" not wider than conduit encasement width "D".

TYPICAL SECTION OF TRENCH
ENCASED CONDUIT

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG250A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

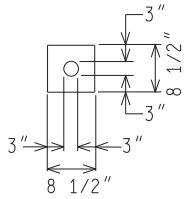
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

CONDUIT
(DIRECT BURIAL/ENCASED)

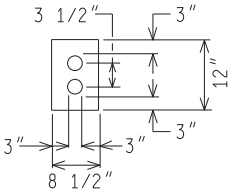
PLAN DATE

SIG-250-A

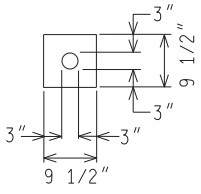
SHEET
1 of 2



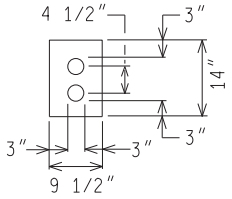
1 2″ CONDUIT



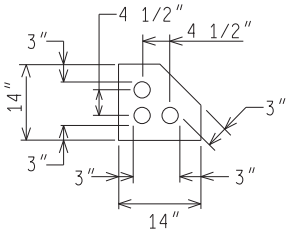
2 2″ CONDUIT



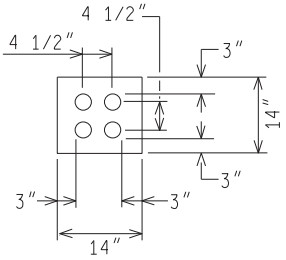
ONE
2 1/2″ CONDUIT



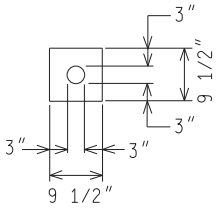
TWO
2 1/2″ CONDUIT



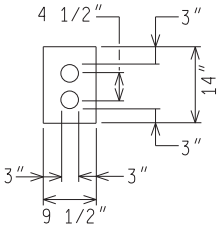
THREE
2 1/2″ CONDUIT



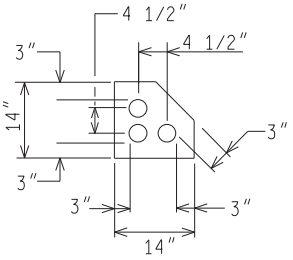
FOUR
2 1/2″ CONDUIT



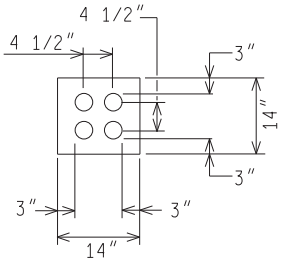
1 3″ CONDUIT



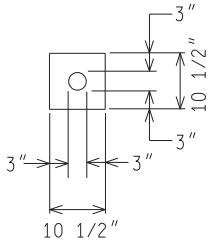
2 3″ CONDUIT



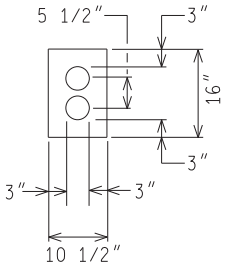
3 3″ CONDUIT



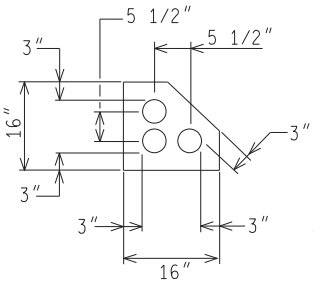
4 3″ CONDUIT



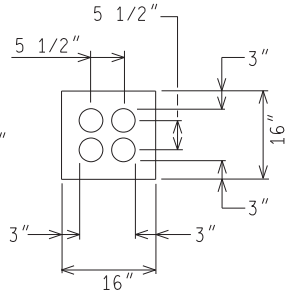
1 4″ CONDUIT



2 4″ CONDUIT



3 4″ CONDUIT

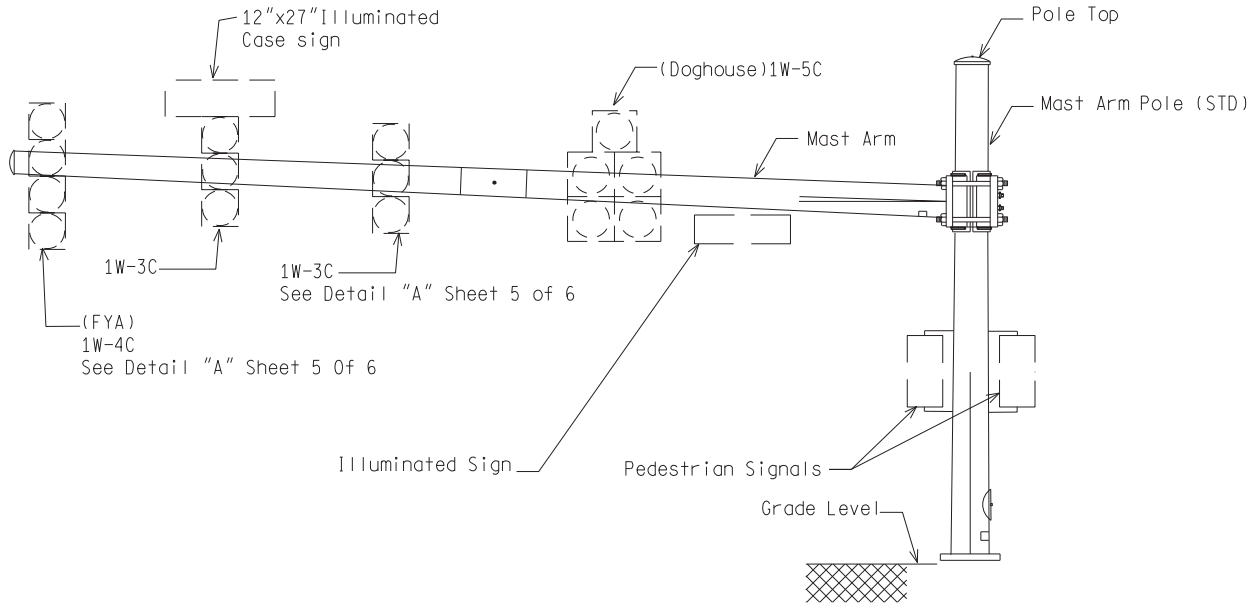


4 4″ CONDUIT

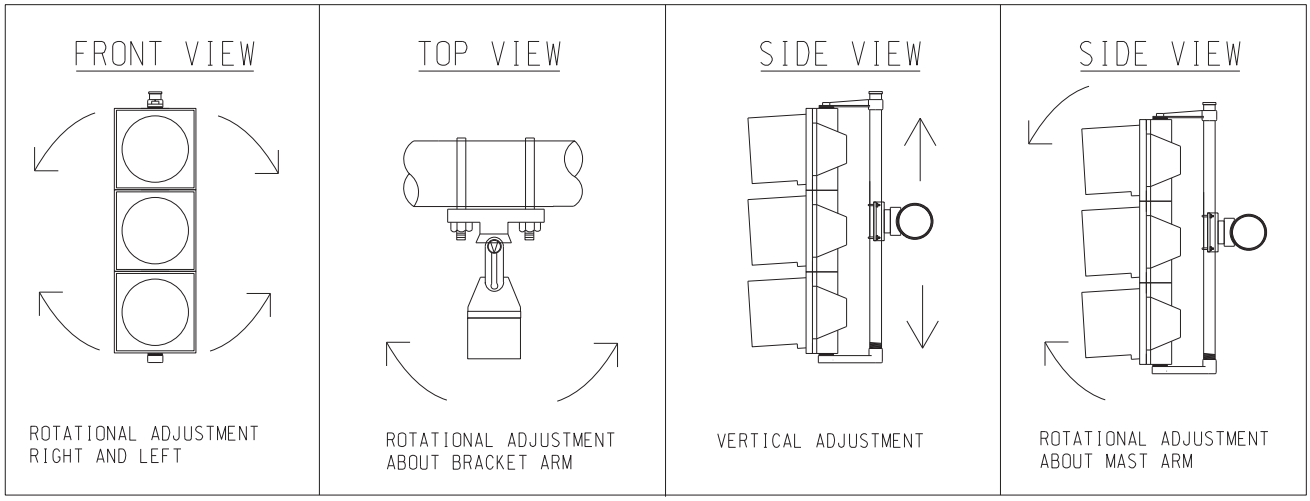
ENCASED CONDUIT SECTIONS

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-250-A	SHEET 2 of 2
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG250A.dgn Rev. 02/16/17		PLAN DATE		



TYPICAL SIGNAL DISPLAYS



SIGNAL HEAD BRACKET ADJUSTMENT

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: JEV

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

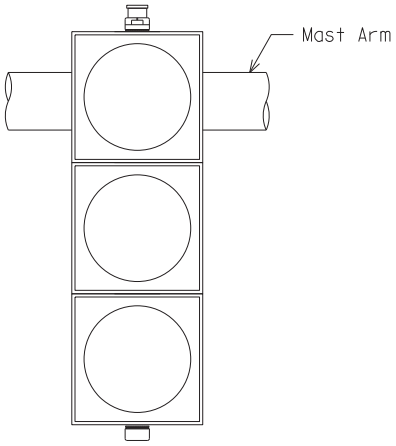
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

MAST ARM MOUNTED T.S. BRACKET ASSEMBLY

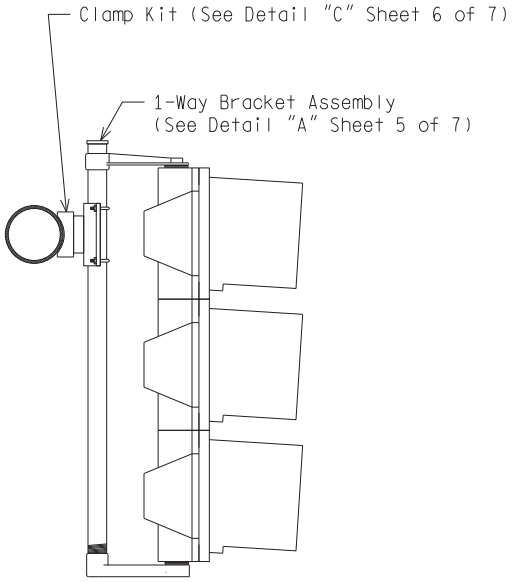
PLAN DATE

SIG-301-A

SHEET 1 of 7

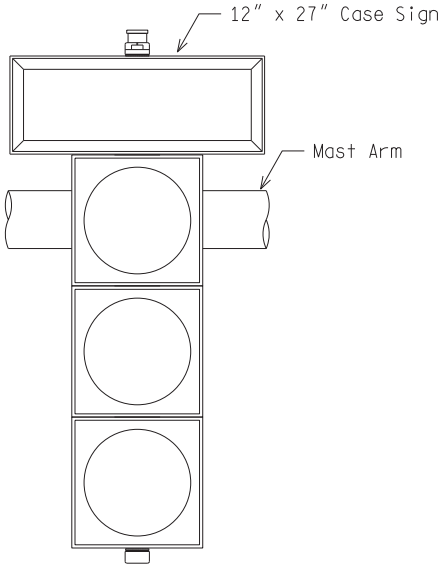


FRONT VIEW

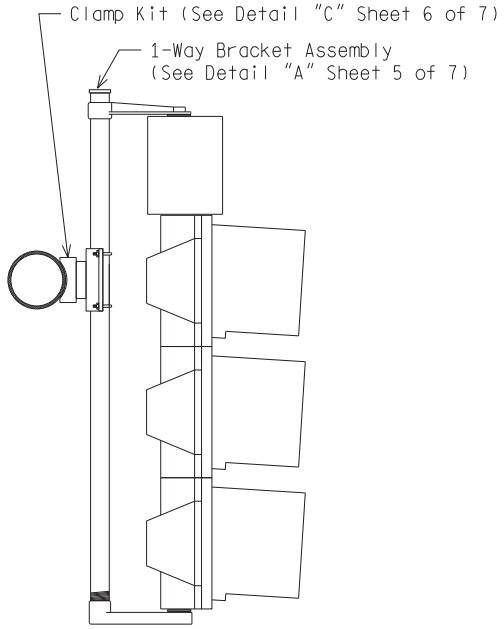


SIDE VIEW

1W-3C



FRONT VIEW

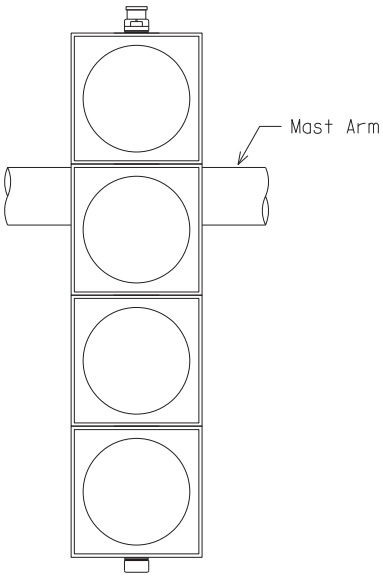


SIDE VIEW

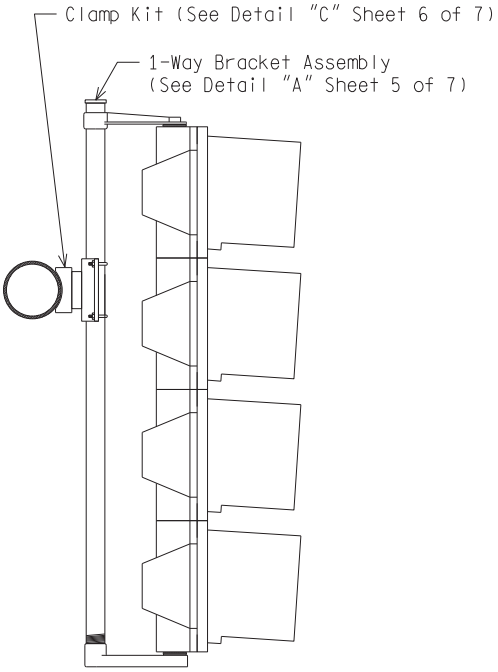
1W-3C With 12" x 27" Case Sign

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-301-A	SHEET 2 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17		PLAN DATE		

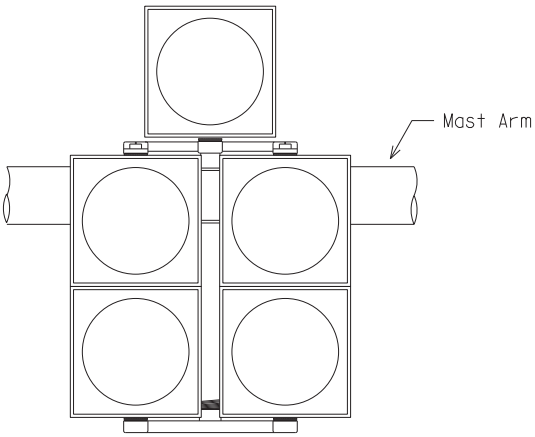


FRONT VIEW

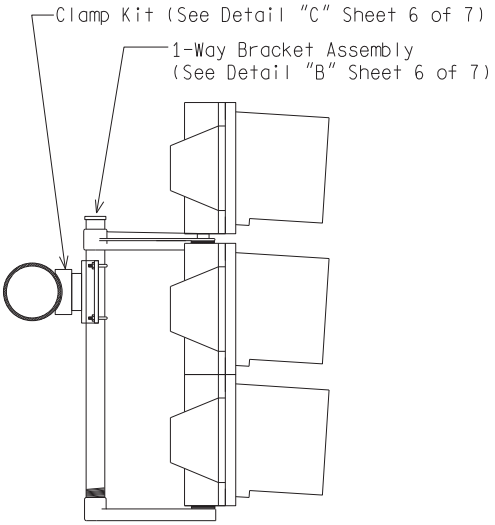


SIDE VIEW

1W-4C (FYA)



FRONT VIEW

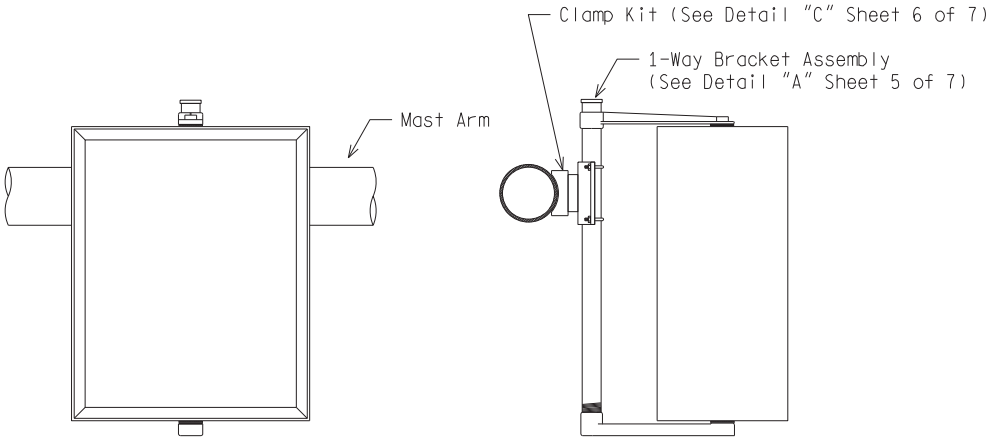


SIDE VIEW

1W-5C (Doghouse)

NOT TO SCALE

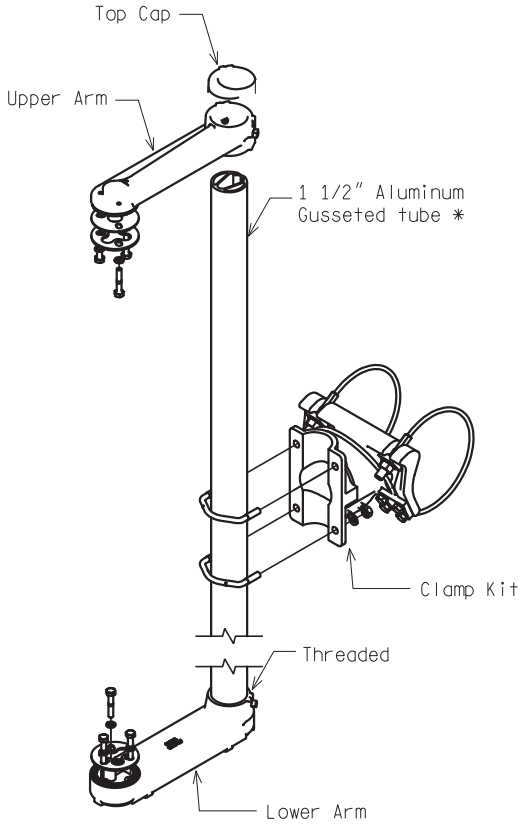
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-301-A	SHEET 3 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17		PLAN DATE		



1W-Case Sign (24" x 30" Shown)

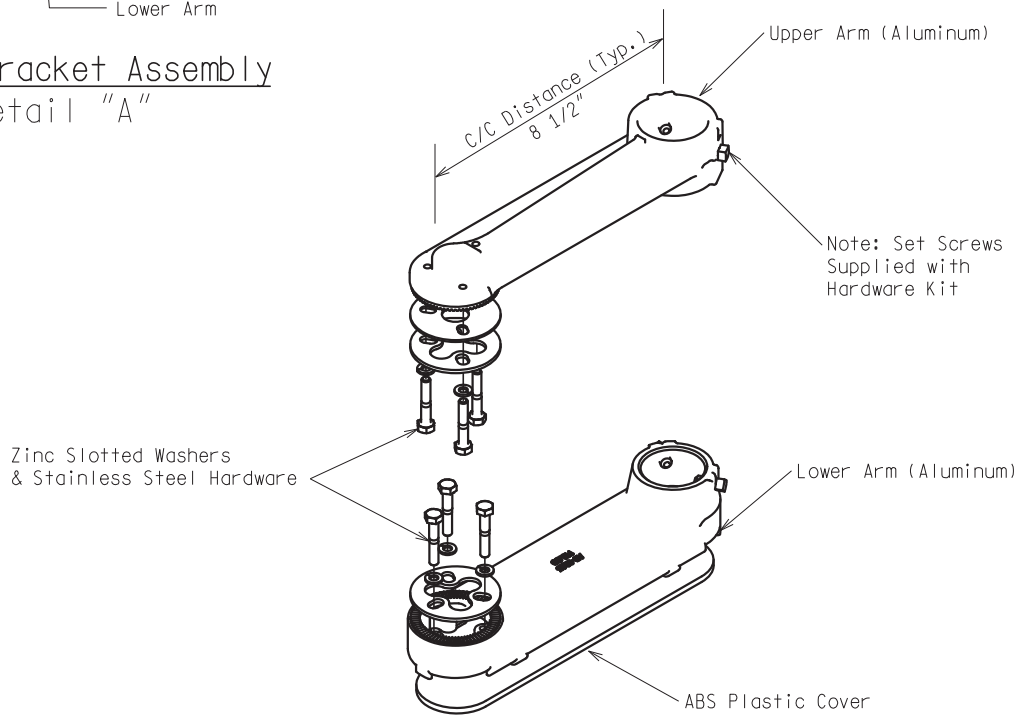
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-301-A	SHEET 4 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17		PLAN DATE		



* Note: Use 46" tube for 3 section T.S.
Use 58" tube for 4 section T.S.

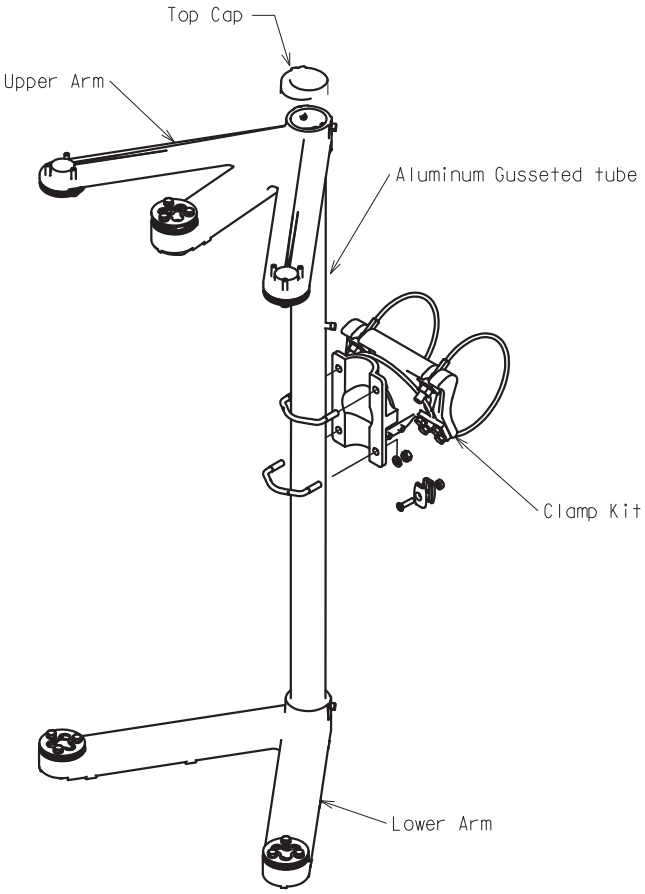
1-WAY Bracket Assembly
Detail "A"



1-WAY Bracket Arm Assembly

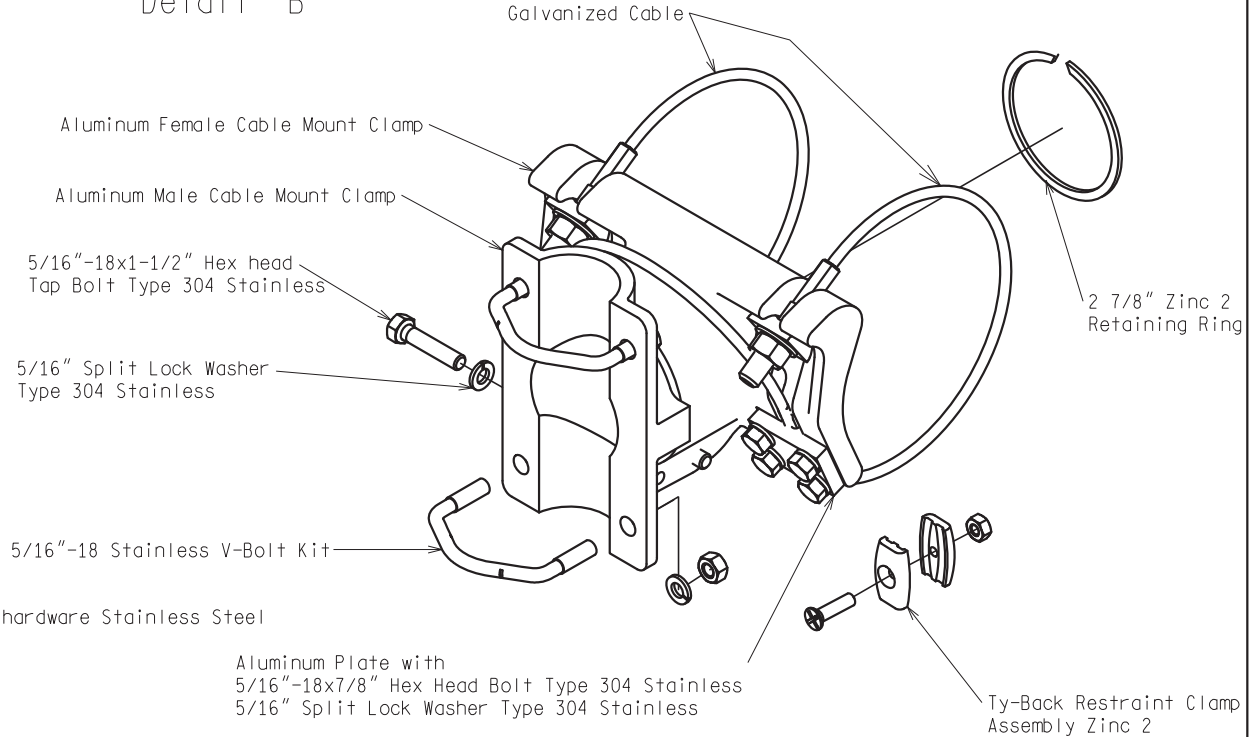
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-301-A	SHEET 5 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17		PLAN DATE		



1-WAY 5-Section Cluster Bracket Assembly

Detail "B"



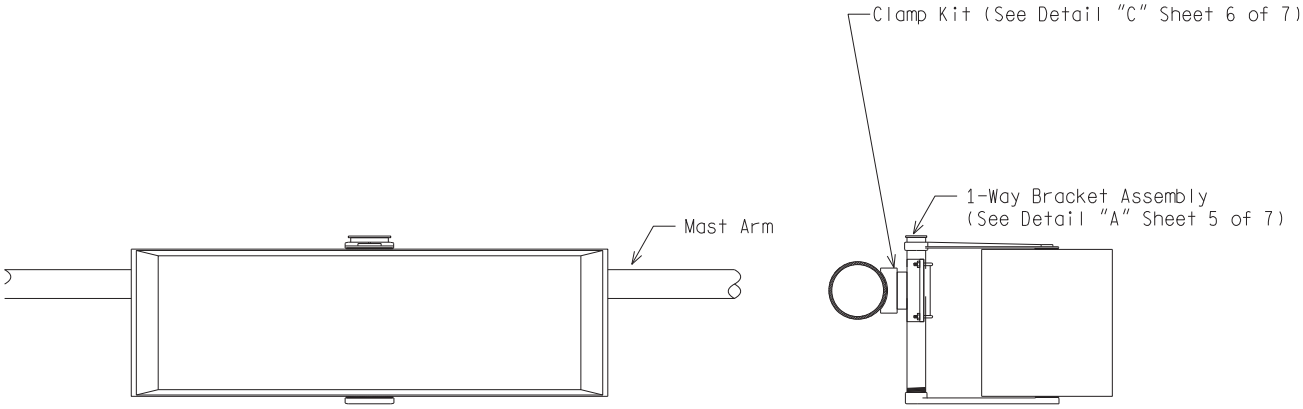
Note: All hardware Stainless Steel

Aluminum Clamp With Galvanized Cable

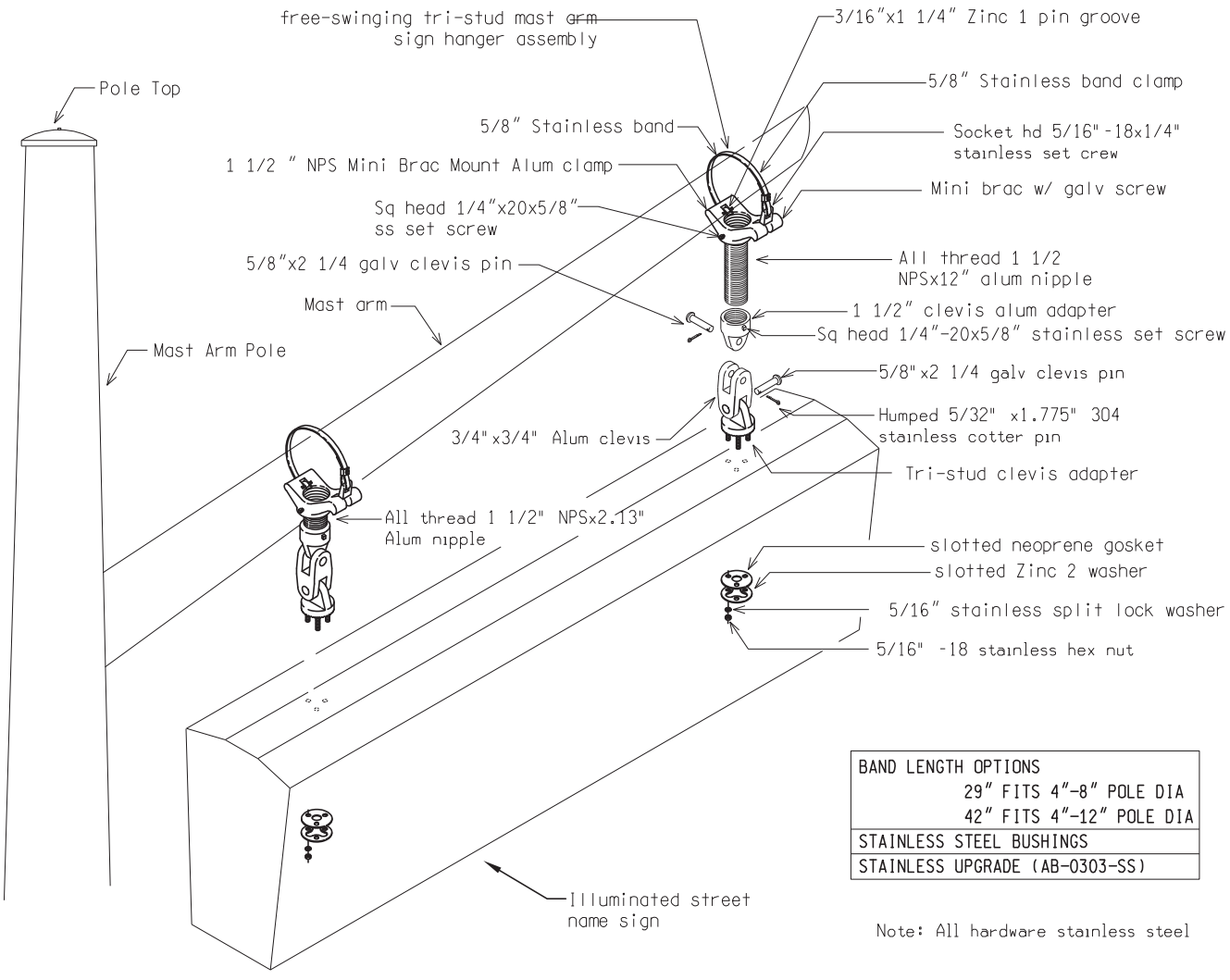
Detail "C"

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-301-A	SHEET 6 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17		PLAN DATE		



1W-Illuminated Street Name Sign



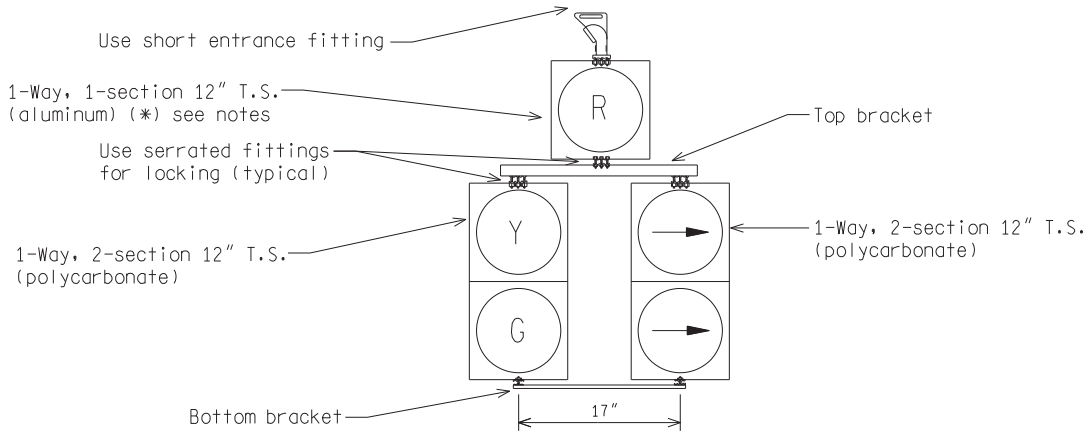
BAND LENGTH OPTIONS
29" FITS 4"-8" POLE DIA
42" FITS 4"-12" POLE DIA
STAINLESS STEEL BUSHINGS
STAINLESS UPGRADE (AB-0303-SS)

Note: All hardware stainless steel

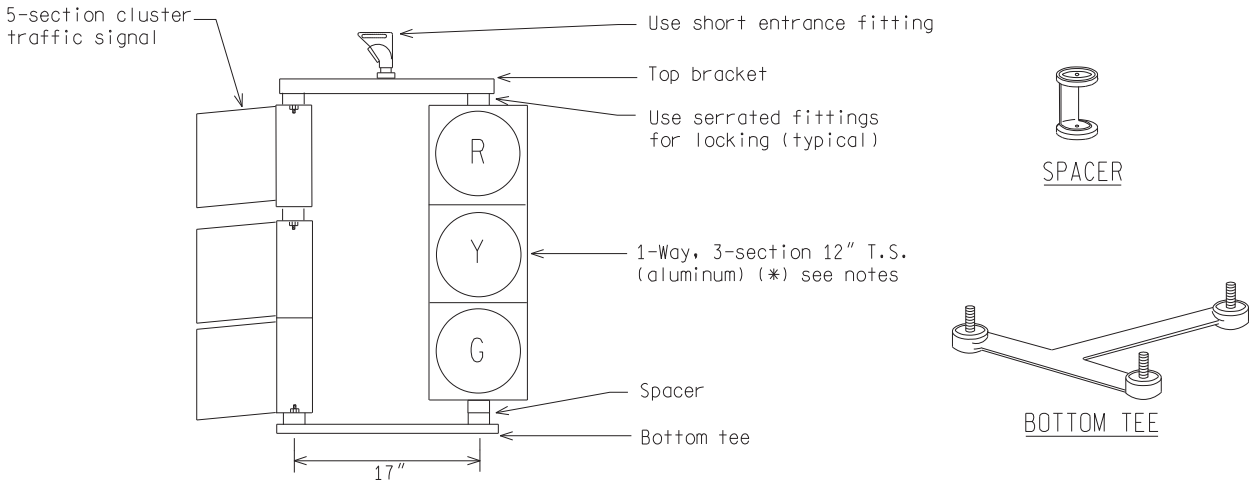
2W-Illuminated Street Name Sign

NOT TO SCALE

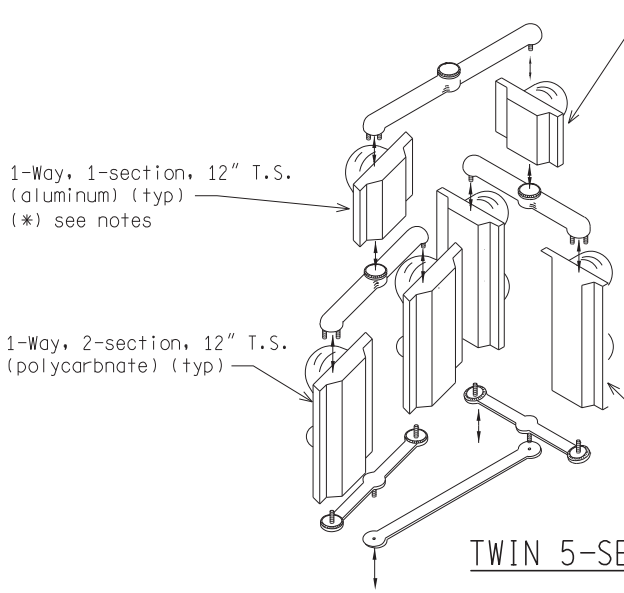
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE	PLAN DATE	SIG-301-A	SHEET 7 of 7
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG301A.dgn Rev. 02/16/17				



5-SECTION CLUSTER (DOGHOUSE) TRAFFIC SIGNAL



COMBINATION 5-SECTION CLUSTER & 1-WAY T.S. (ALUMINUM)



(*) NOTES:

1) Traffic signals must conform to the current ITE publication "Vehicle Traffic Control Signal Heads."
2) Provide cast aluminum alloy housings with a 2" diam. hole top and bottom to receive 1 1/2" inch supporting pipe.
3) Provide a detachable, sheet aluminum visor (min. 0.057" thick), for each signal indication.
4) Provide twist on slots for visor mounting that are either in the visor or on the tabs formed on the visor.

TWIN 5-SECTION CLUSTER TRAFFIC SIGNAL

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG302A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

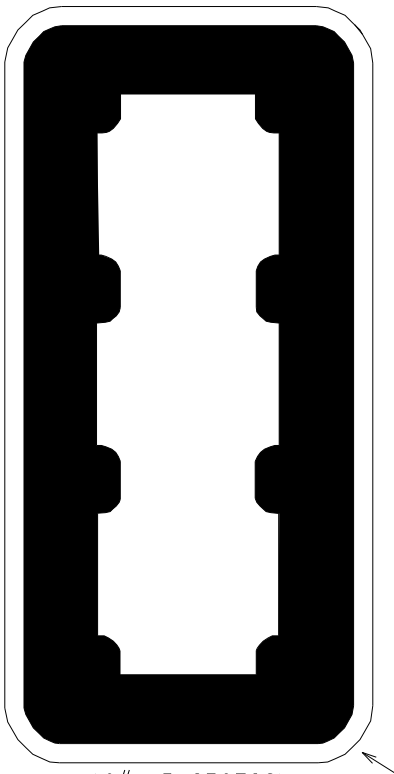
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

BRACKETING FOR 5-SECTION HEADS

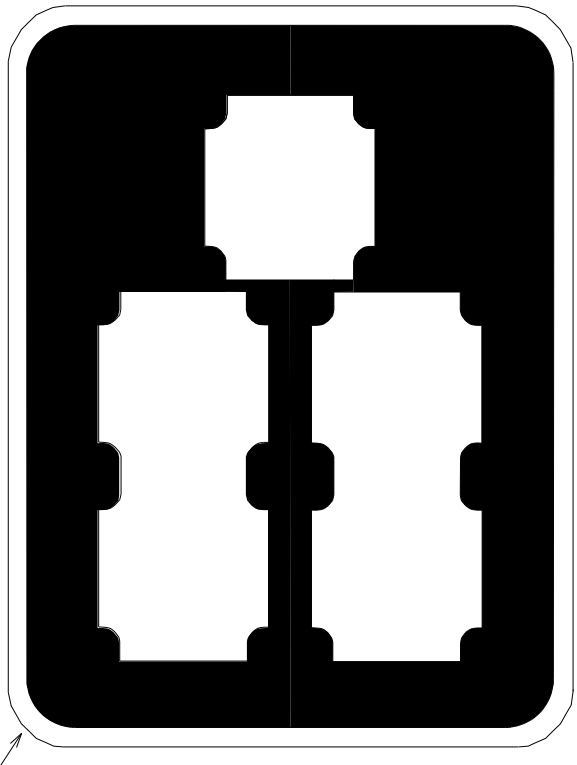
PLAN DATE

SIG-302-A

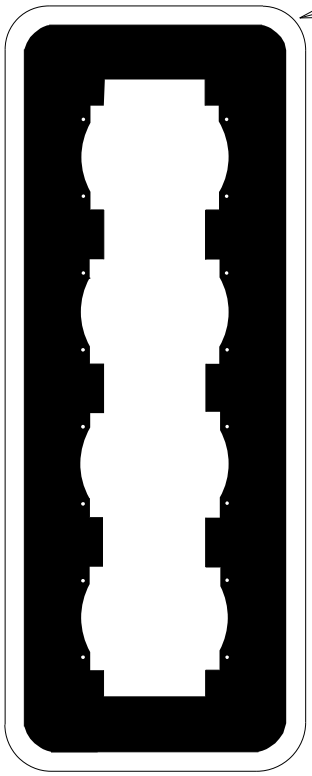
SHEET 1 of 1



12", 3 SECTION



12", 5 SECTION



12", 4 SECTION

ASTM Type Reflective yellow,
and fluorescent yellow tape border

NOTES:

1) Backplates are to be used for mast arm type (fixed support) or tethered span wire type installations as indicated on the plans or as directed by the Engineer.

2) Backplates must be a one piece construction unless otherwise directed by the Engineer.

3) Do not cut the backplate for installation.

4) Use one inch border ASTM Type (Reflective yellow, and fluorescent yellow tape border) and Yellow signal heads with visors.

TRAFFIC SIGNAL BACKPLATES

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG304A.dgn Rev. 11/13/20

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

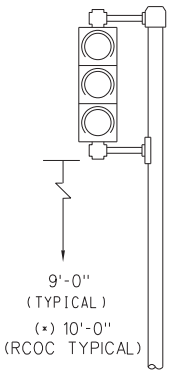
TRAFFIC SIGNAL BACKPLATES

PLAN DATE

SIG-304-A

SHEET 1 of 1

(*) Refer to Note 4 on Sheet 2 of 2.



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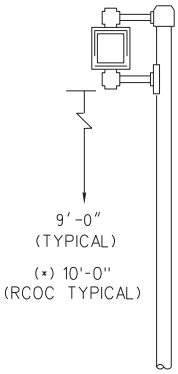
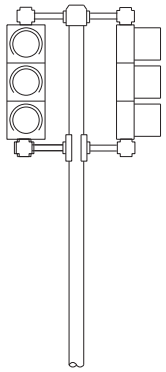
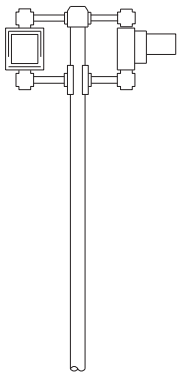


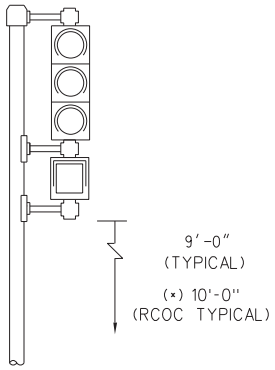
DETAIL "B-2"



DETAIL "C-2"



DETAIL "D-2"



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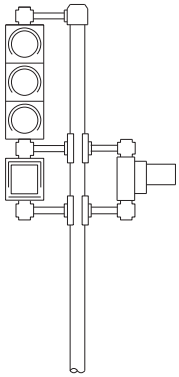
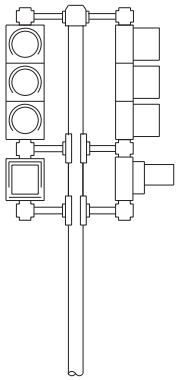
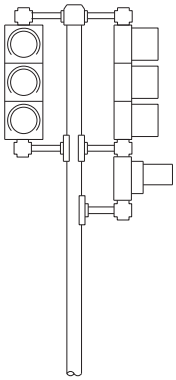


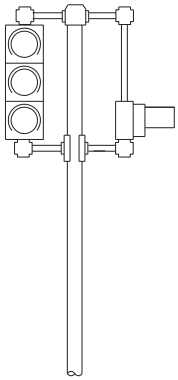
DETAIL "F-2"



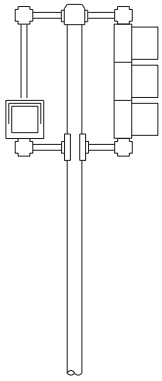
DETAIL "G-2"



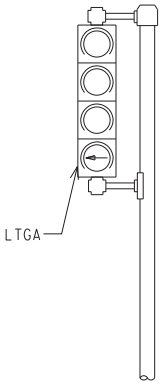
DETAIL "H-2"



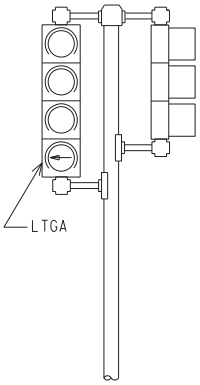
DETAIL "I-2"



DETAIL "J-2"



DETAIL "K-2"



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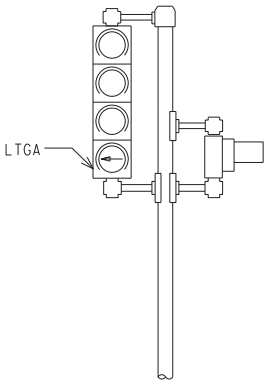

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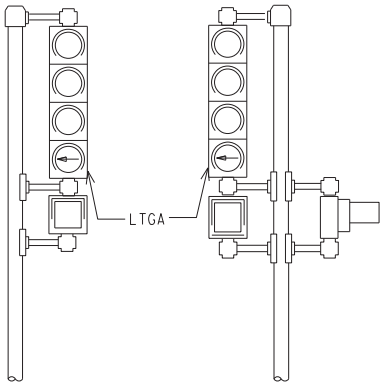


DETAIL "N-2"

DETAIL "O-2"

Left Turn Green Arrow (LTGA)

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG330A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

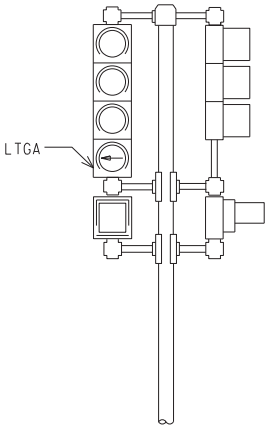
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

PEDESTAL MOUNTED SIGNAL DISPLAYS

PLAN DATE

SIG-330-A

SHEET 1 of 2



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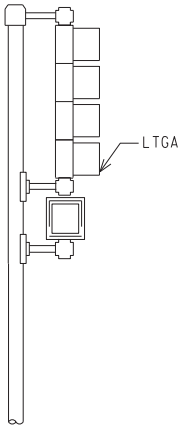
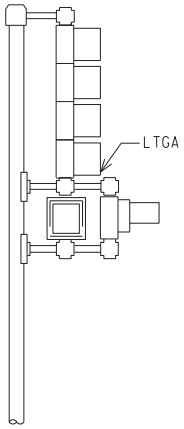
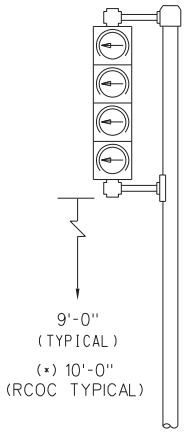


DETAIL "Q-2"

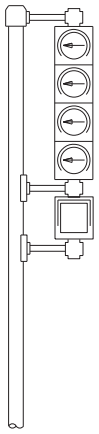


DETAIL "R-2"

Left Turn Green Arrow (LTGA)

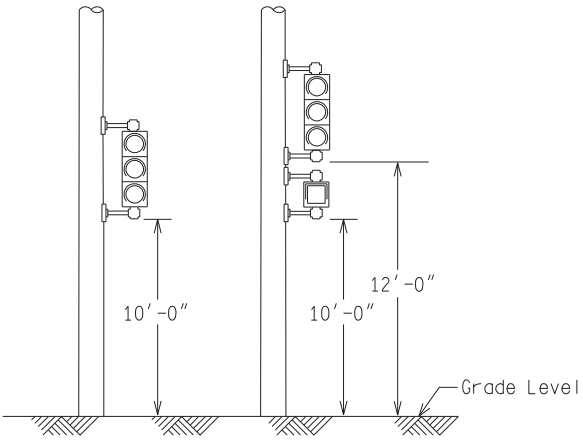


DETAIL "S-2"
(FYA)

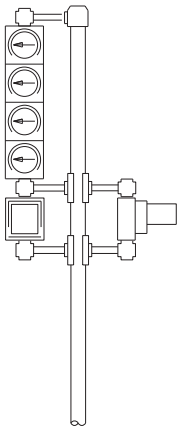


DETAIL "T-2"
(FYA)

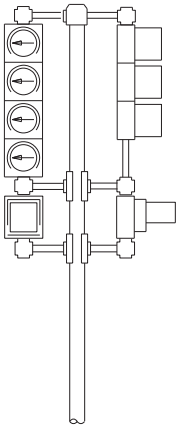
Flashing Yellow Arrow (FYA)



RCOC Mounting Detail (*) see note

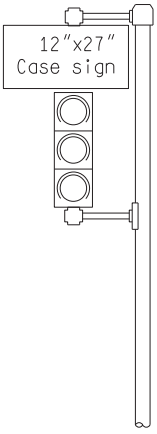


DETAIL "U-2"
(FYA)



DETAIL "V-2"
(FYA)

Flashing Yellow Arrow (FYA)



DETAIL "Typical"
WITH CASE SIGN

NOTE:

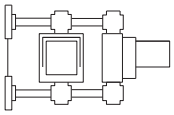
1) Pipe assembly shall be such length and height as to accommodate traffic signals and pedestrian signals for proper maintenance and clear vehicular and pedestrian viewing.

2) Pipe assembly shall be of such length and height as to accommodate an illuminated (12"x27") case sign for proper maintenance and clear vehicular viewing.

3) Bracket lengths are 16 inches for LED pedestrian signals and for LED pedestrian countdown signals.

4) Tolerance within +/- 1/8" for bracketing.

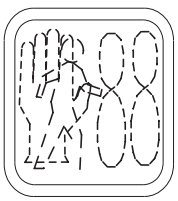
(*) For projects maintained by the Road Commission for Oakland County (RCOC), use the bottom heights and bracket assemblies as shown for the RCOC mounting detail.



LED PED

NOTE:
Walking person and hand symbol are filled.

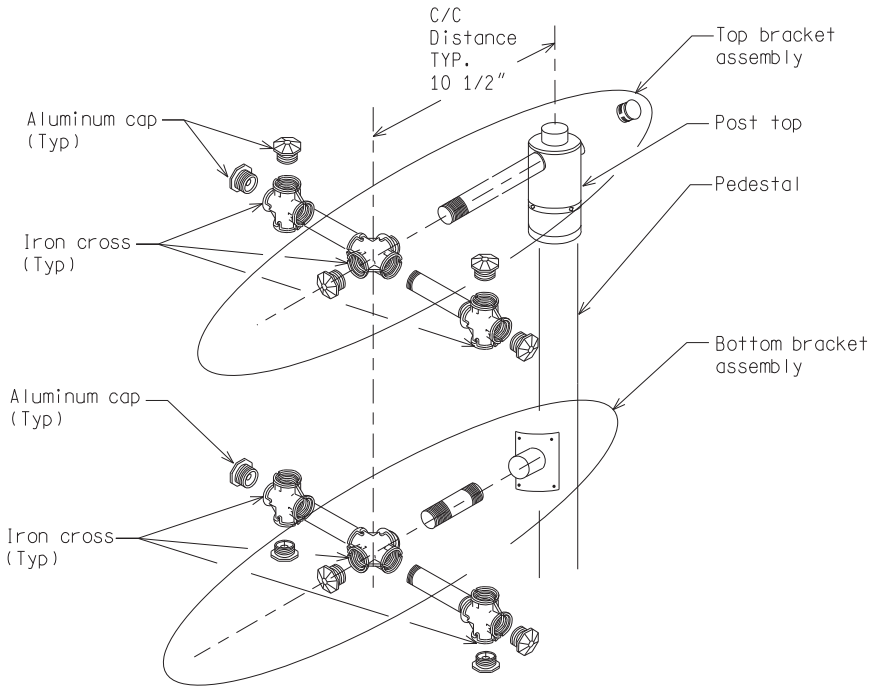
LED PED
(filled)



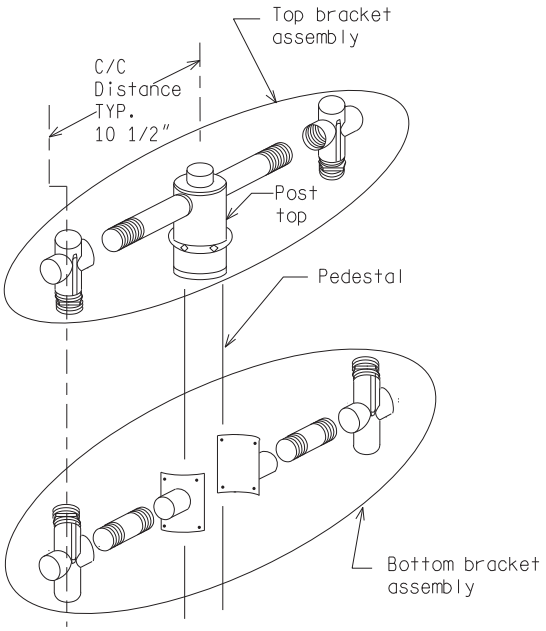
Countdown
LED PED
(filled symbols)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG330A.dgn Rev. 02/16/17		PLAN DATE	SIG-330-A	SHEET 2 of 2



SIGNAL MOUNTING HARDWARE FOR BACKSIDE BRACKET



SIGNAL MOUNTING HARDWARE - STANDARD BRACKET

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG331A.dgn Rev.

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: DSP

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

FHWA APPROVAL DATE

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

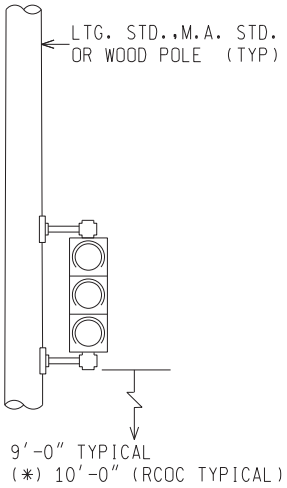
PEDESTAL MOUNTING FOR SIGNALS

02/16/17
PLAN DATE

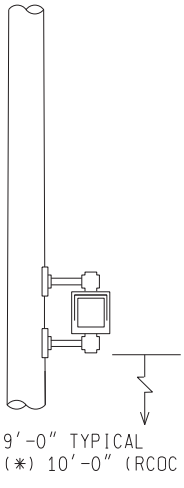
SIG-331-A

SHEET
1 of 1

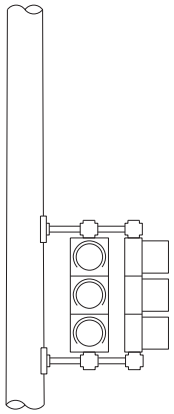
(*) Refer to Note 5 on Sheet 2 of 2.



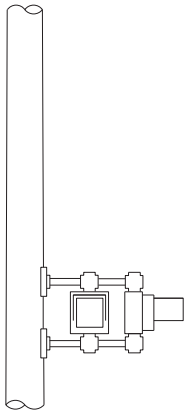
DETAIL "A-1"



DETAIL "B-1"



DETAIL "C-1"



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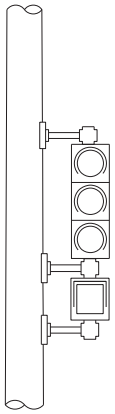

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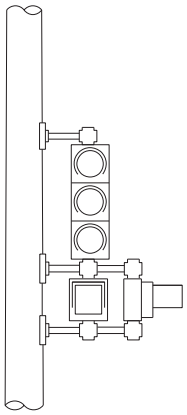
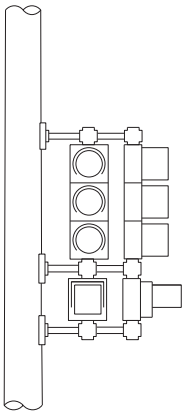
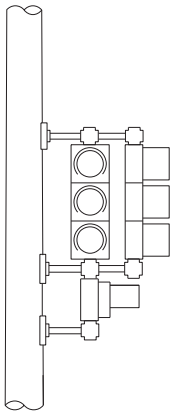


DETAIL "F-1"



DETAIL "G-1"



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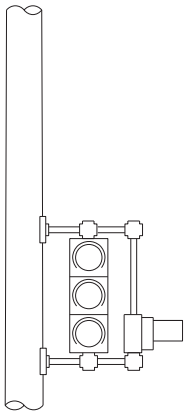

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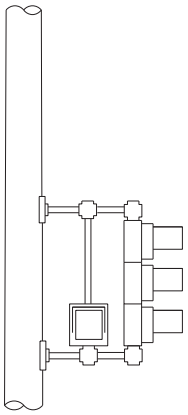

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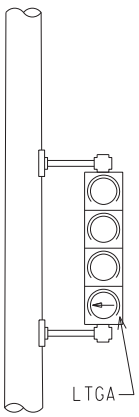
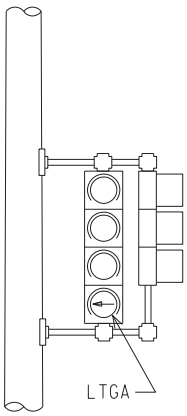


DETAIL "K-1"



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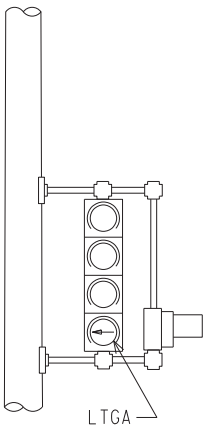

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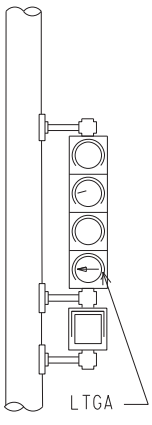
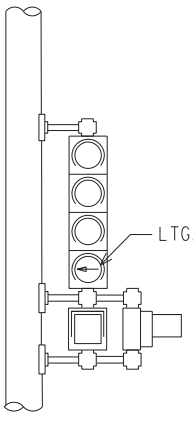
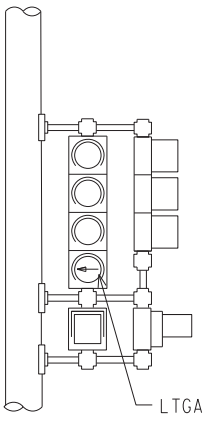


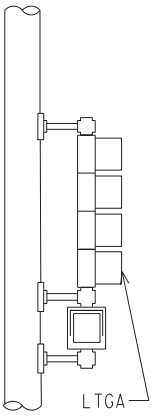
DETAIL "N-1"



DETAIL "O-1"



DETAIL "P-1"



DETAIL "Q-1"

Left Turn Green Arrow (LTGA)

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG340A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

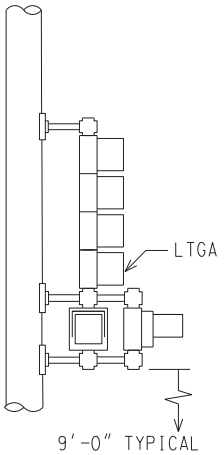
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

POLE MOUNTED SIGNAL DISPLAYS

PLAN DATE

SIG-340-A

SHEET 1 of 2



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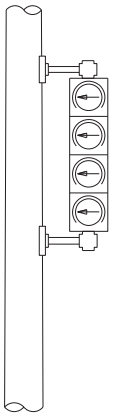
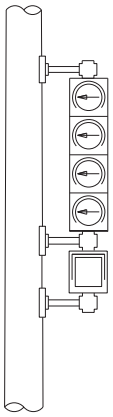


DETAIL "S-1"
(FYA)



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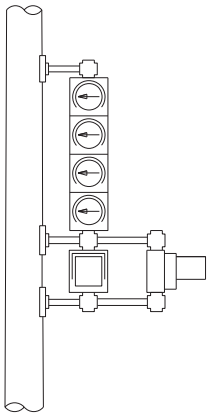
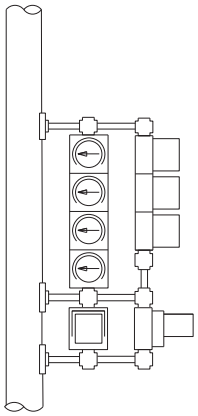
(FYA)

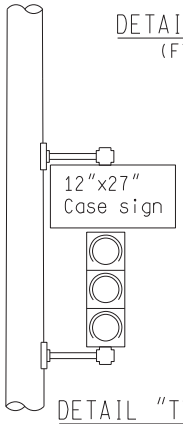


DETAIL "U-1"
(FYA)

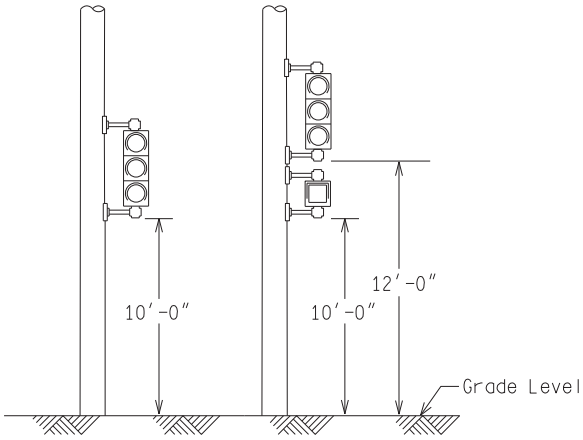


DETAIL "V-1"
(FYA)

Flashing Yellow Arrow (FYA)



DETAIL "TYPICAL"
WITH CASE SIGN



RCOC Mounting Detail (∗) see note

NOTES:

1) The relative position of 2-Way T.S. & pedestrian bracket arm signals within the bracket assembly shall be reversed (i.e. the signal nearest the pole goes to the outside of the bracket assembly & the outside signal goes inboard or nearest to pole) according to the plan view to provide clear vehicular and pedestrian viewing.

2) Pipe assembly shall be of such length and height as to accommodate traffic signals and pedestrian signals for proper maintenance and clear vehicular and pedestrian viewing.

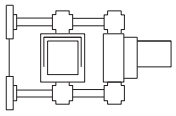
3) Pipe assembly shall be of such length and height as to accommodate an illuminated (12″x27″) case sign for proper maintenance and clear vehicular viewing.

4) Bracket lengths are 16 inches for LED pedestrian signals and LED pedestrian countdown signals.

5) For poles located 6′ or less from face of curb, contact Engineer for traffic and/or pedestrian bracket type and orientation if field installation requires a change from information shown on the plans.

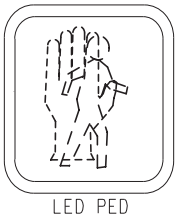
6) Tolerance within +/- 1/8″ for bracketing.

(∗) For projects maintained by the Road Commission for Oakland County (RCOC), use the bottom heights and bracket assemblies as shown for the RCOC mounting detail.

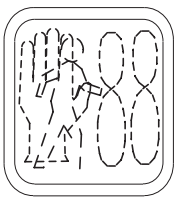


LED PED

NOTE:
Walking person and hand symbol are filled.



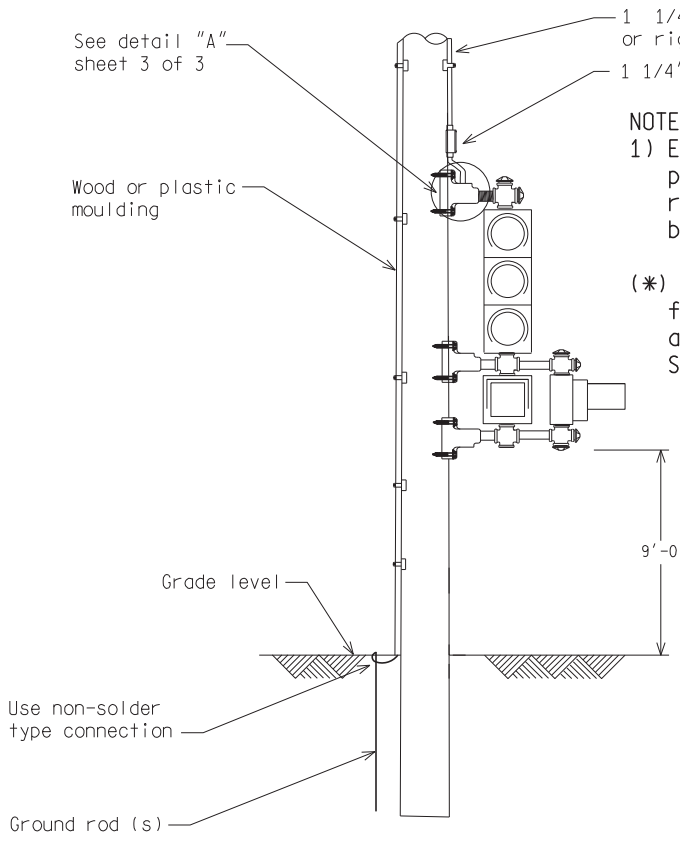
LED PED
(filled)



Countdown
LED PED
(filled symbols)

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG340A.dgn Rev. 02/16/17		PLAN DATE	SIG-340-A	SHEET 2 of 2

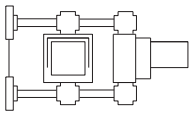


WOOD POLE

NOTES:

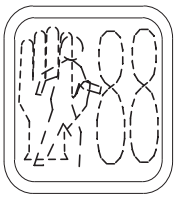
1) Exterior surface of all mounting assemblies for pedestrian signals including brackets, nuts and related hardware shall be weather- resistant black enamel.

(*) For projects maintained by the Road Commission for Oakland County (RCOC), use the bottom heights and bracket assemblies as shown on SIG-028A, SIG-029A or SIG-029B for the RCOC Mounting Detail.



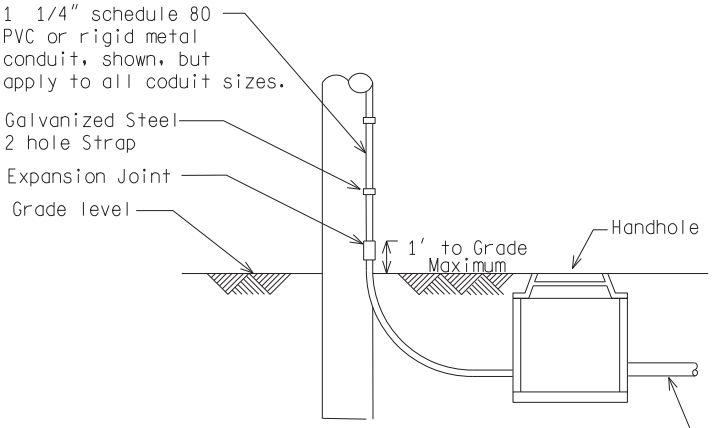
LED ped

LED PED (filled)

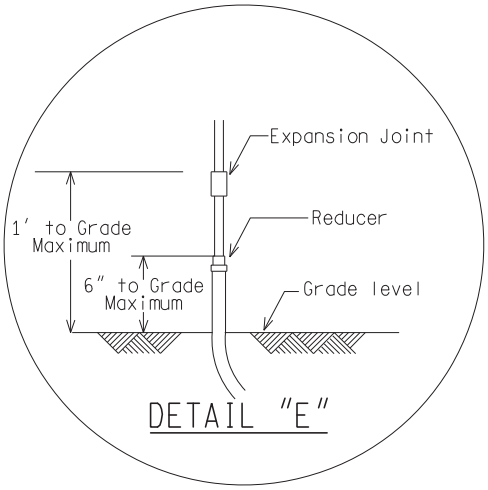


Countdown LED PED (filled symbols)

OVERHEAD FEED



WOOD POLE



DETAIL "E"

NOTE:
If rigid metal conduit is used, the conduit must be bonded according to the current N.E.C.

Schedule 80 PVC conduit (size of conduit as shown on plans)

UNDERGROUND ALTERNATE (COUPLING NOT SHOWN)

NOT TO SCALE

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MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

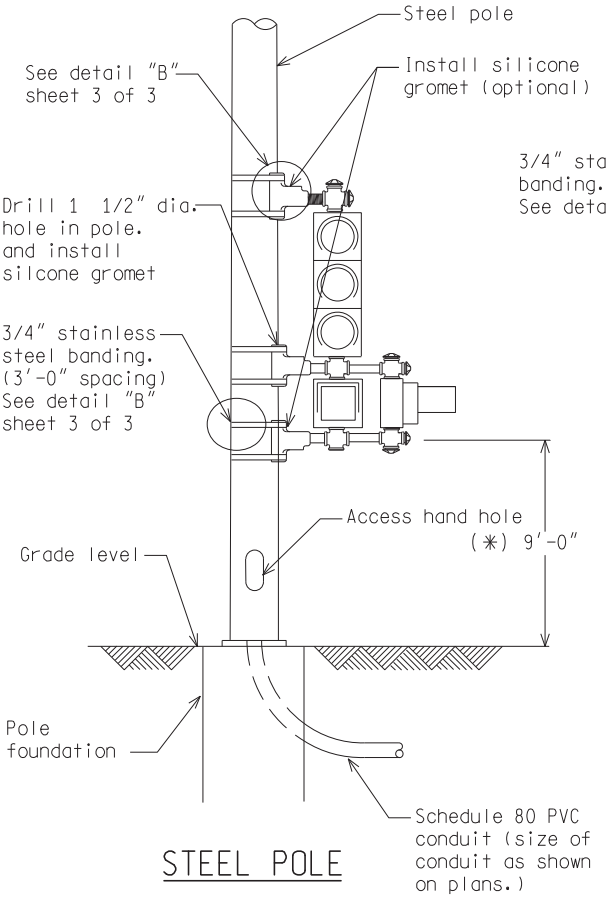
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

POLE MOUNTING DETAILS FOR SIGNALS

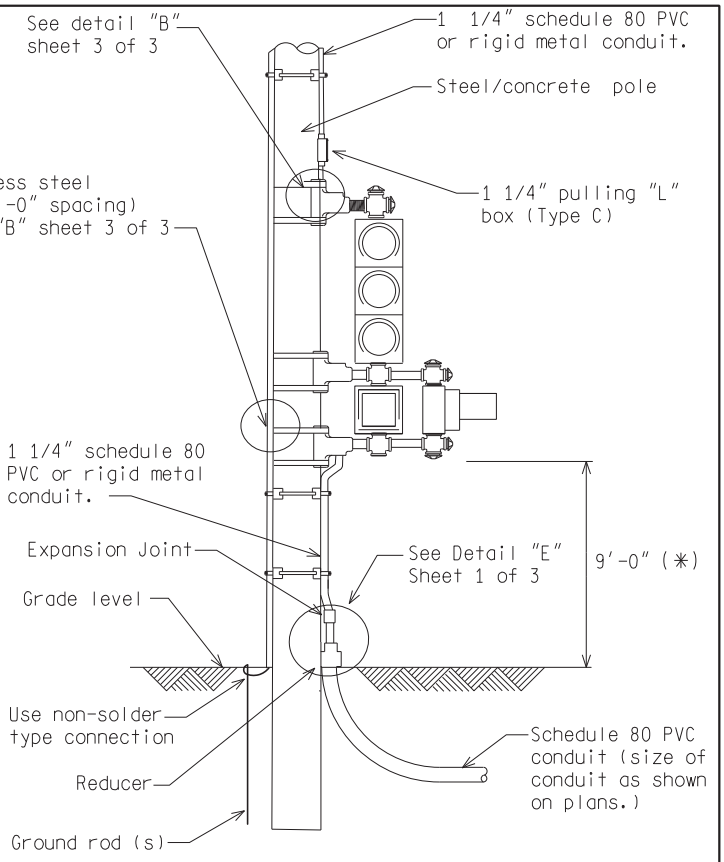
PLAN DATE

SIG-341-A

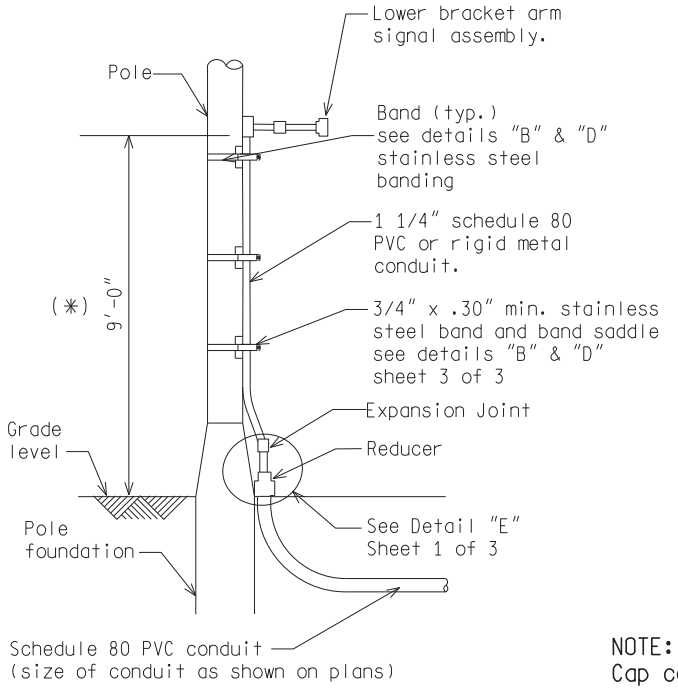
SHEET 1 of 3



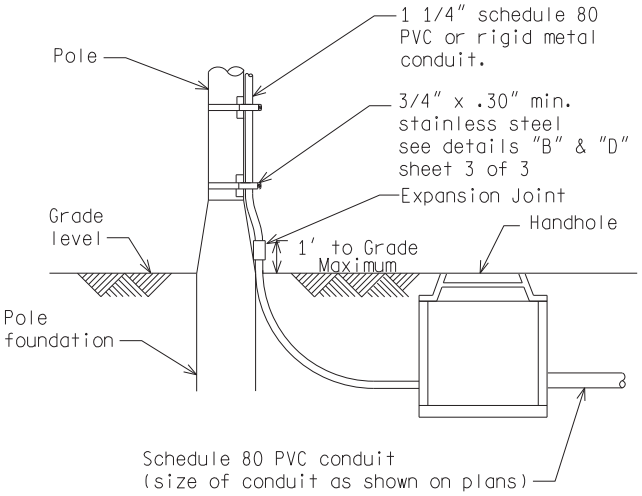
STEEL POLE



STEEL STREET LIGHT POLE
OR CONCRETE POLE

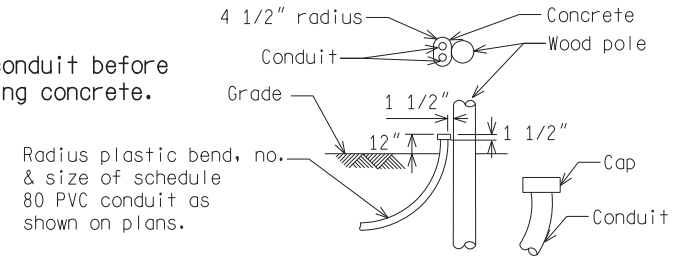


INSTALLATION OF CONDUIT
ON OUTSIDE OF POLE



INSTALLATION OF CONDUIT
ON OUTSIDE OF POLE (ALTERNATE)

NOTE:
Cap conduit before pouring concrete.

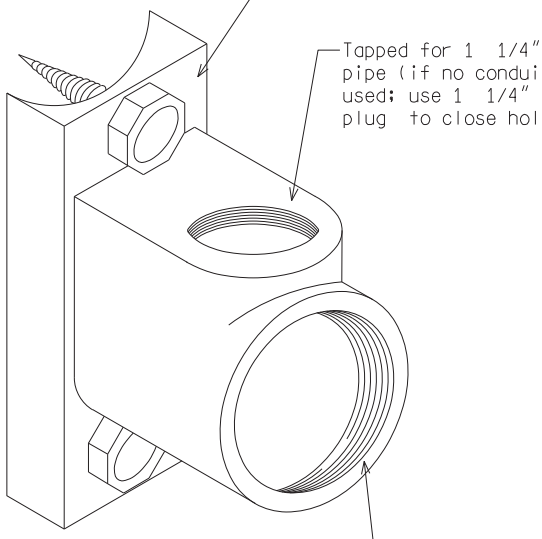


INSTALLATION OF CONDUIT AT CABLE POLE

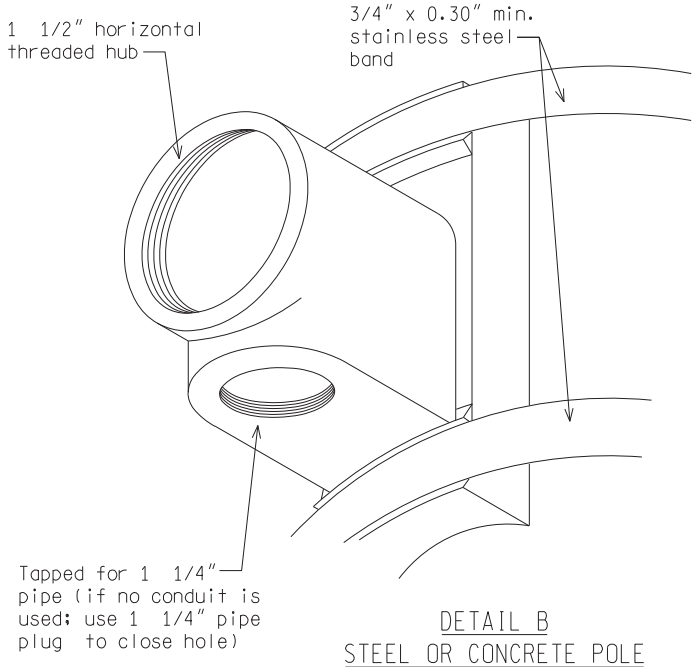
(*) Refer to Note 2 on Sheet 1 of 3.

NOT TO SCALE

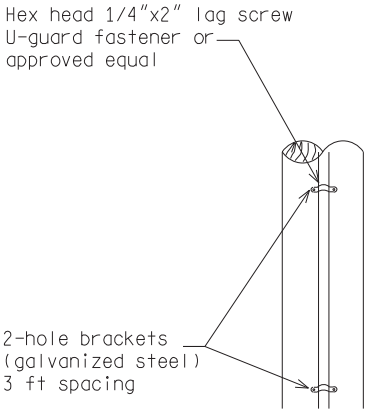
MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-341-A	SHEET 2 of 3
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG341A.dgn Rev. 02/16/17		PLAN DATE		



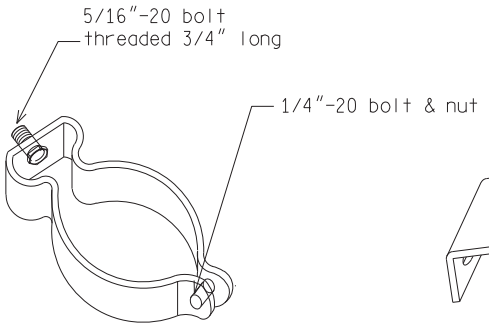
DETAIL A
WOOD POLE



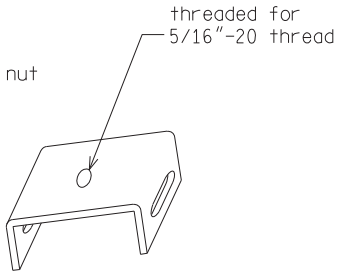
DETAIL B
STEEL OR CONCRETE POLE



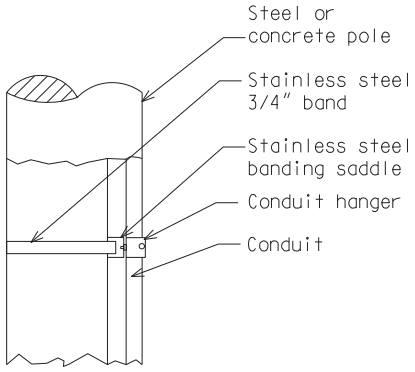
DETAIL C
TYPICAL CONDUIT ATTACHMENT
TO WOOD POLE



HANGER
To fit conduit size hanger as called for on plans.
(zinc plated)



BANDING SADDLE



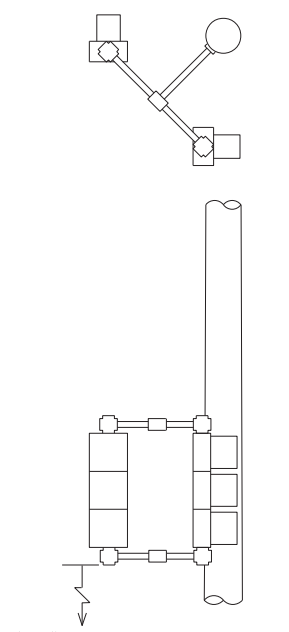
DETAIL D
TYPICAL CONDUIT ATTACHMENT
TO STEEL OR CONCRETE POLE.

NOTES:
1) Install 3/4" x 10'-0" copper clad ground rod (s) as required to provide less than 10 ohm resistance to ground. install #6 min. copper wires from ground rod (s) to span wire at each supporting pole using non-solder type connections for span wire ground.

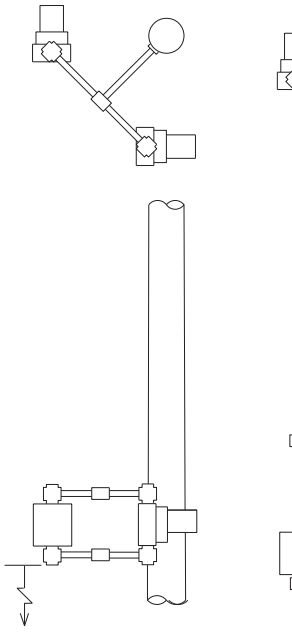
2) Use conduit size specified (min.) unless current N.E.C. indicates a larger size is required.

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE			
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG341A.dgn Rev. 02/16/17		PLAN DATE	SIG-341-A	SHEET 3 of 3



DETAIL "A-3"



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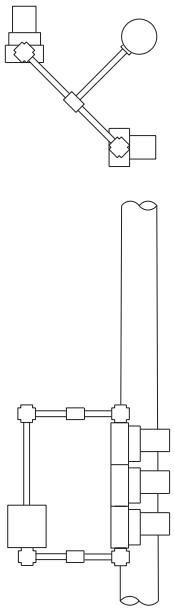

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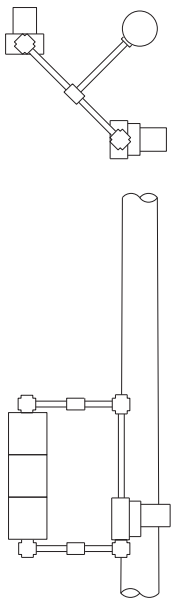
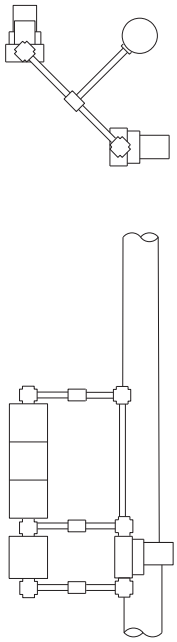
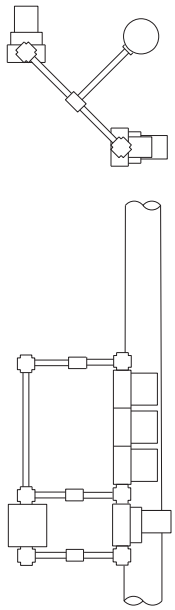


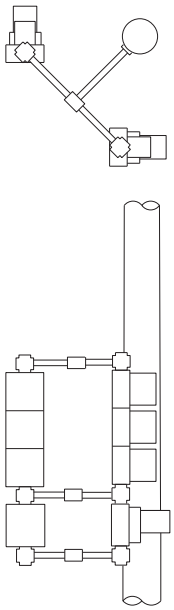
DETAIL "D-3"



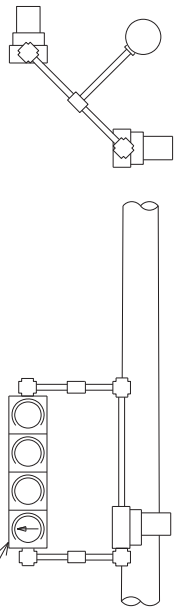
DETAIL "E-3"



DETAIL "F-3"



DETAIL "G-3"



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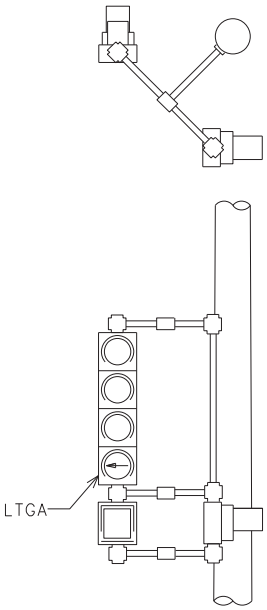


DETAIL "I-3"

Left Turn Green Arrow (LTGA)

(*) Refer to Note 5 on Sheet 2 of 2.

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG342A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

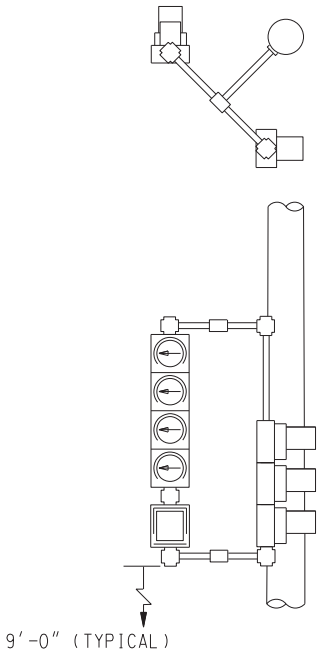
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

BACK BRACKET SIGNAL DISPLAYS

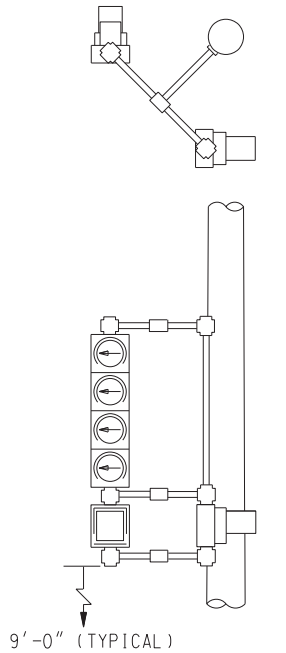
PLAN DATE

SIG-342-A

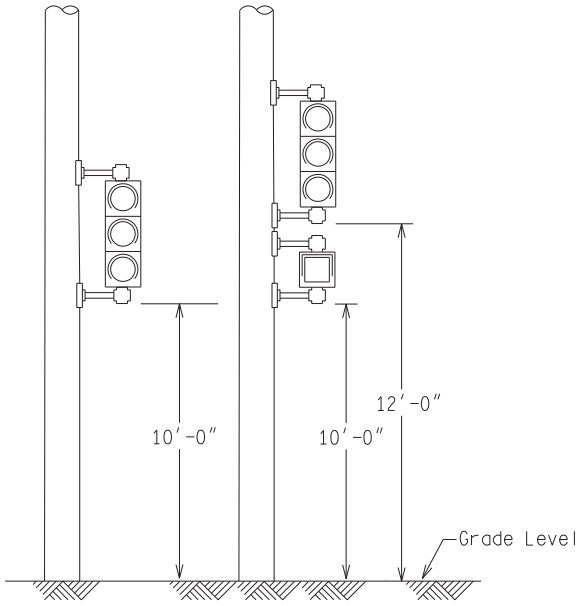
SHEET 1 of 2



DETAIL "J-3"
(FYA)

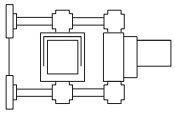


DETAIL "K-3"
(FYA)



RCOC Mounting Detail (*) see note

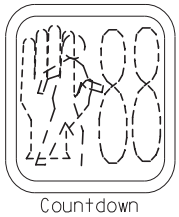
Flashing Yellow Arrow (FYA)



LED PED

NOTES: Walking person and hand symbol are filled.

LED PED
(filled)



Countdown
LED PED
(filled symbols)

NOTES:

1) The relative position of 2-Way T.S. & pedestrian bracket arm signals within the bracket assembly shall be reversed (i.e. the signal nearest the pole goes to the outside of the bracket assembly & the outside signal goes inboard or nearest to pole) according to the plan view to provide clear vehicular and pedestrian viewing.

2) Pipe assembly shall be of such length and height as to accommodate traffic signals and pedestrian signals for proper maintenance and clear vehicular and pedestrian viewing.

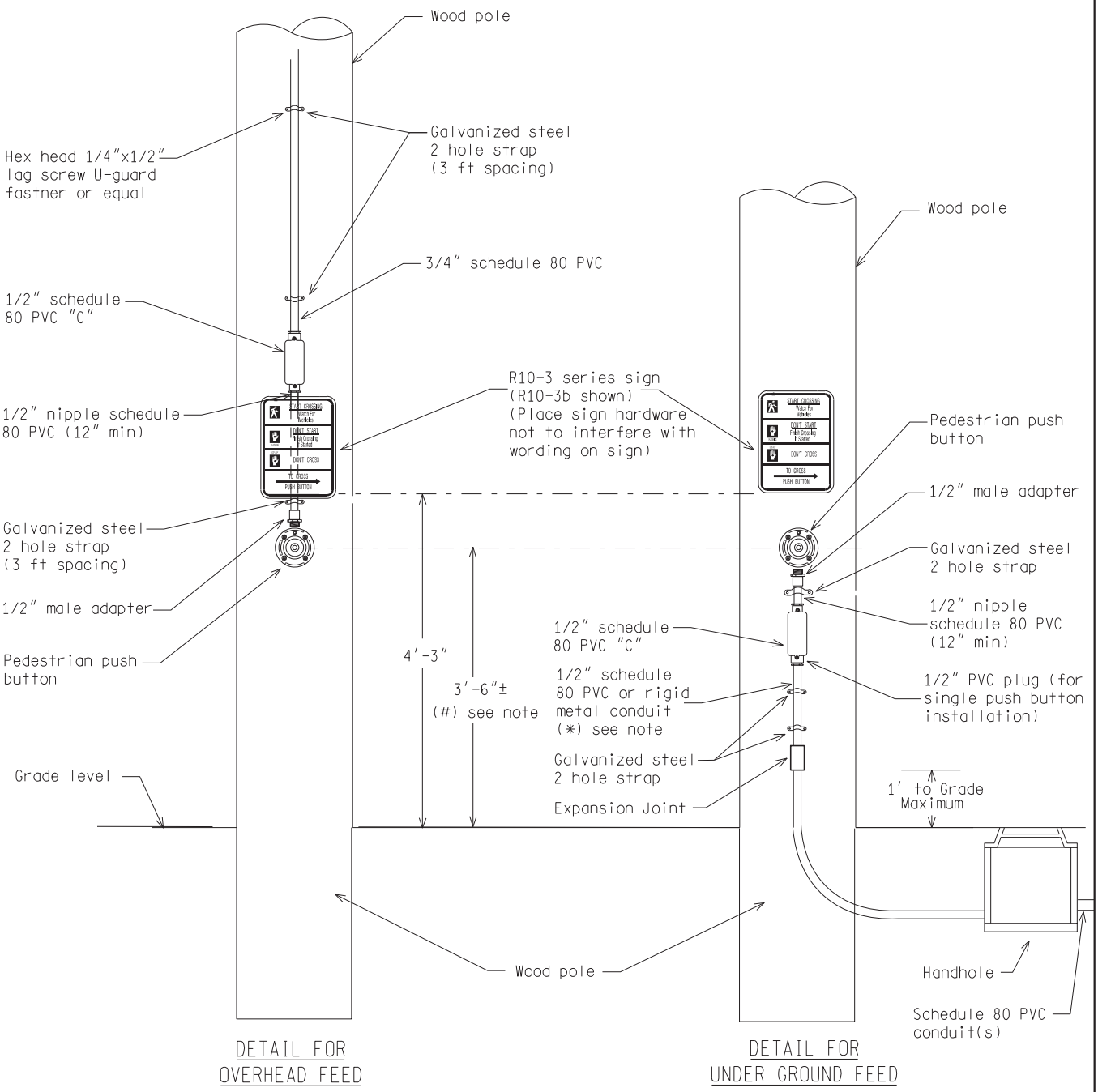
3) Pipe assembly shall be of such length and height as to accommodate an illuminated (12"x27") case sign for proper maintenance and clear vehicular viewing.

4) Bracket lengths are 16 inches for LED pedestrian signals and LED pedestrian countdown signals.

6) Tolerance within +/- $\frac{1}{8}$" for bracketing.

(*) For projects maintained by the Road Commission for Oakland County (RCOC), use the bottom heights and bracket assemblies as shown for the RCOC mounting detail.

NOT TO SCALE



Note: (*) For projects maintained by the Wayne Co. Department of Public Services (WCDPS), use rigid metal for conduit(s) from grade level to 10' (min.) above grade or as directed by the Engineer.

(#) If pushbutton is from 10" to 24" from edge of sidewalk an acceptable range is 38" to 46"

PEDESTRIAN PUSH BUTTON DETAILS ON WOOD POLE

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG400A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY TRAFFIC AND SAFETY

DRAWN BY:

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)

FHWA APPROVAL DATE

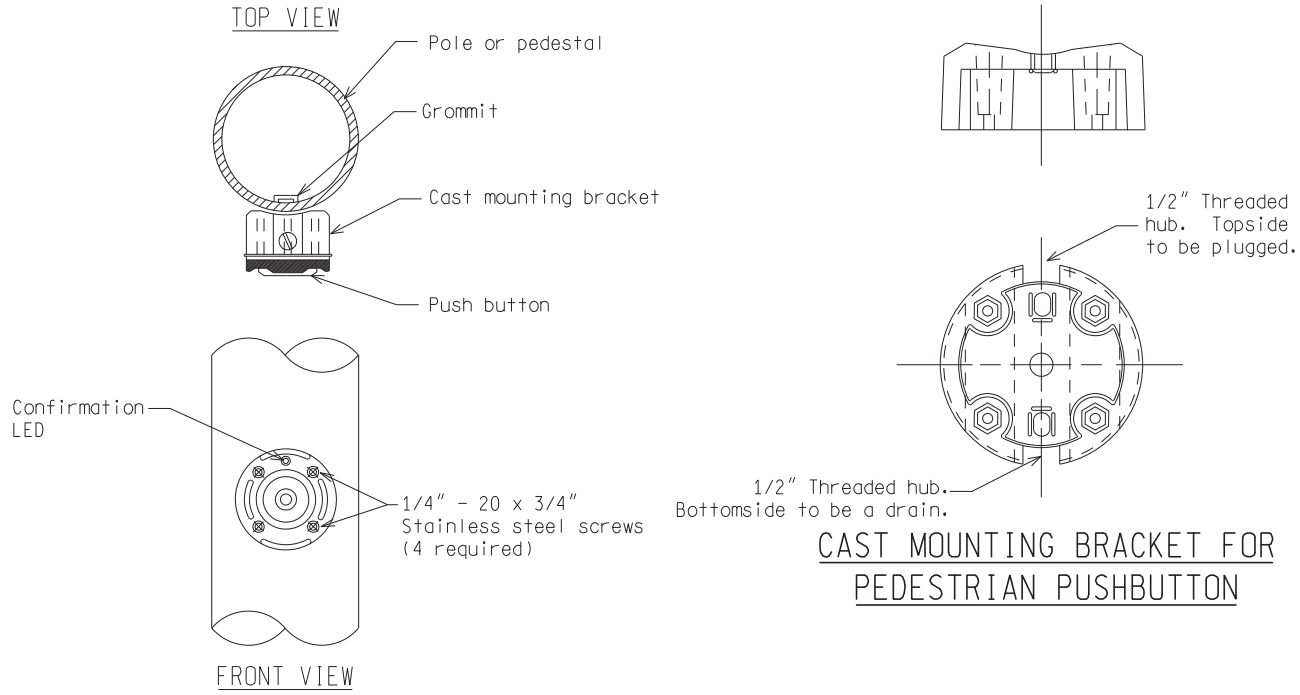
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

PEDESTRIAN PUSH BUTTON DETAILS

PLAN DATE

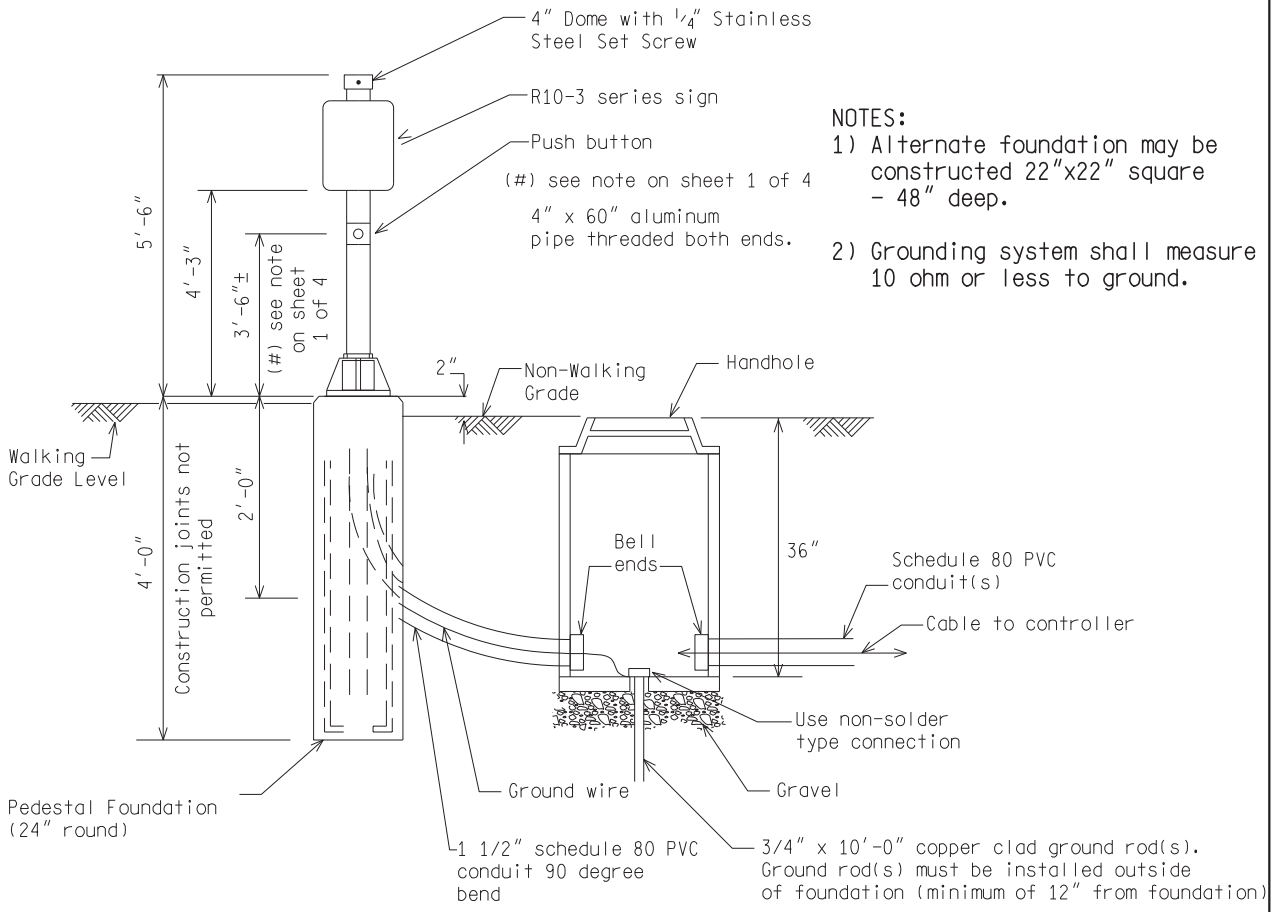
SIG-400-A

SHEET 1 of 4



CAST MOUNTING BRACKET FOR PEDESTRIAN PUSHBUTTON

PEDESTRIAN PUSHBUTTON INSTALLATION ON STEEL POLE OR PEDESTAL

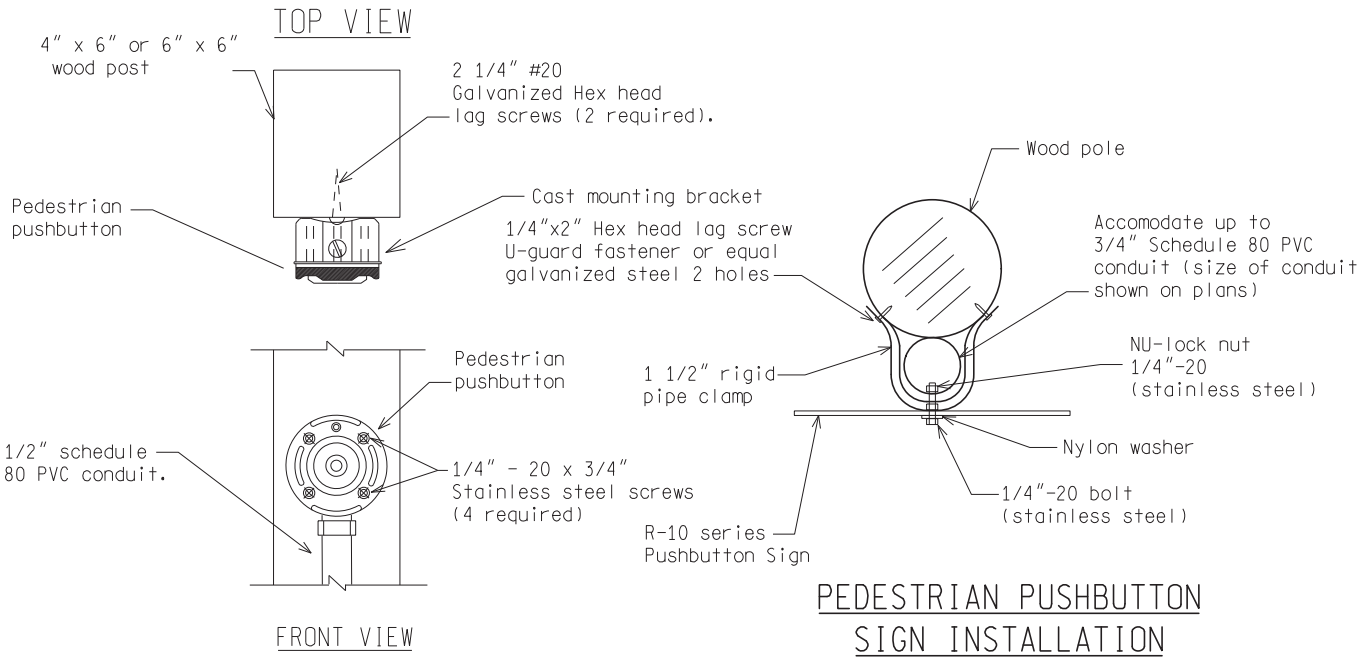


NOTES:
1) Alternate foundation may be constructed 22"x22" square - 48" deep.
2) Grounding system shall measure 10 ohm or less to ground.

PUSH BUTTON PEDESTAL

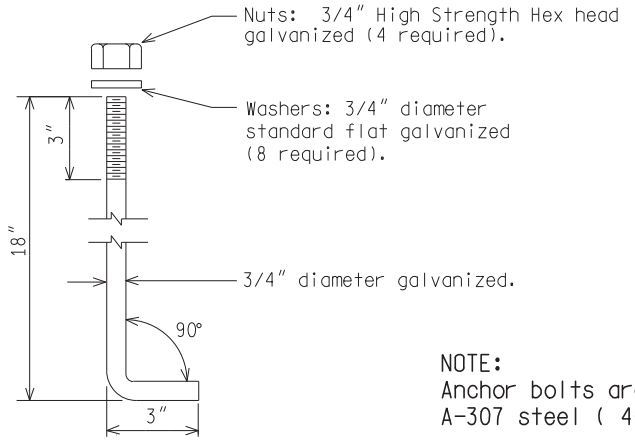
NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-400-A	SHEET 2 of4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG400A.dgn Rev. 02/16/17		PLAN DATE		



PEDESTRIAN PUSHBUTTON INSTALLATION ON WOOD POST

PEDESTRIAN PUSHBUTTON SIGN INSTALLATION ON WOOD POLE

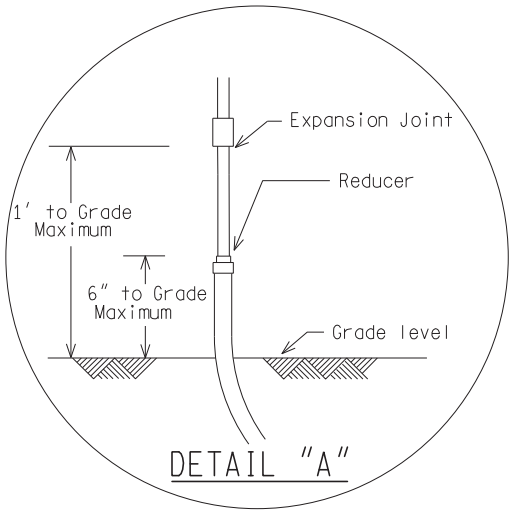


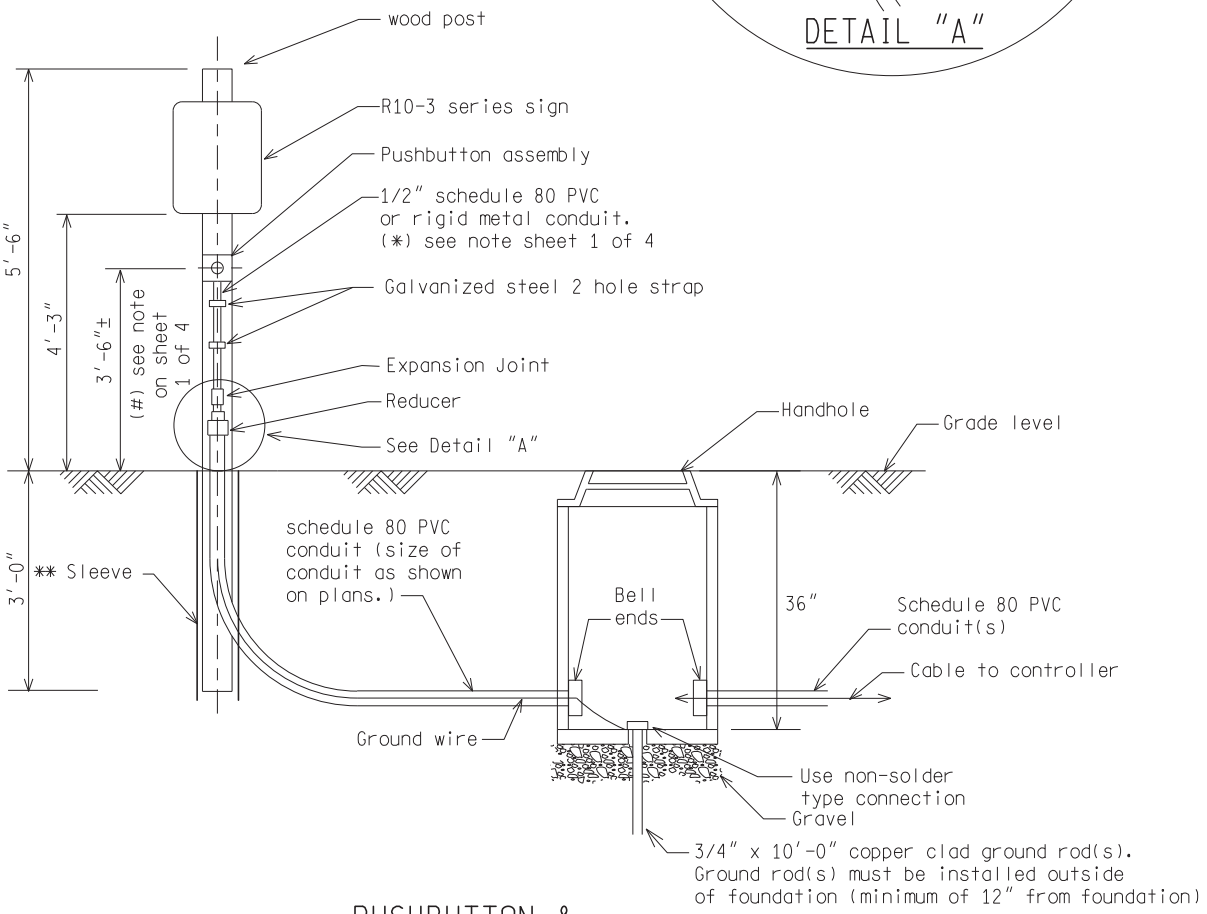
NOTE:
Anchor bolts are to be ASTM A-307 steel (4-required)

ANCHOR BOLT DETAIL

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-400-A	SHEET 3 of 4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG400A.dgn Rev. 02/16/17		PLAN DATE		



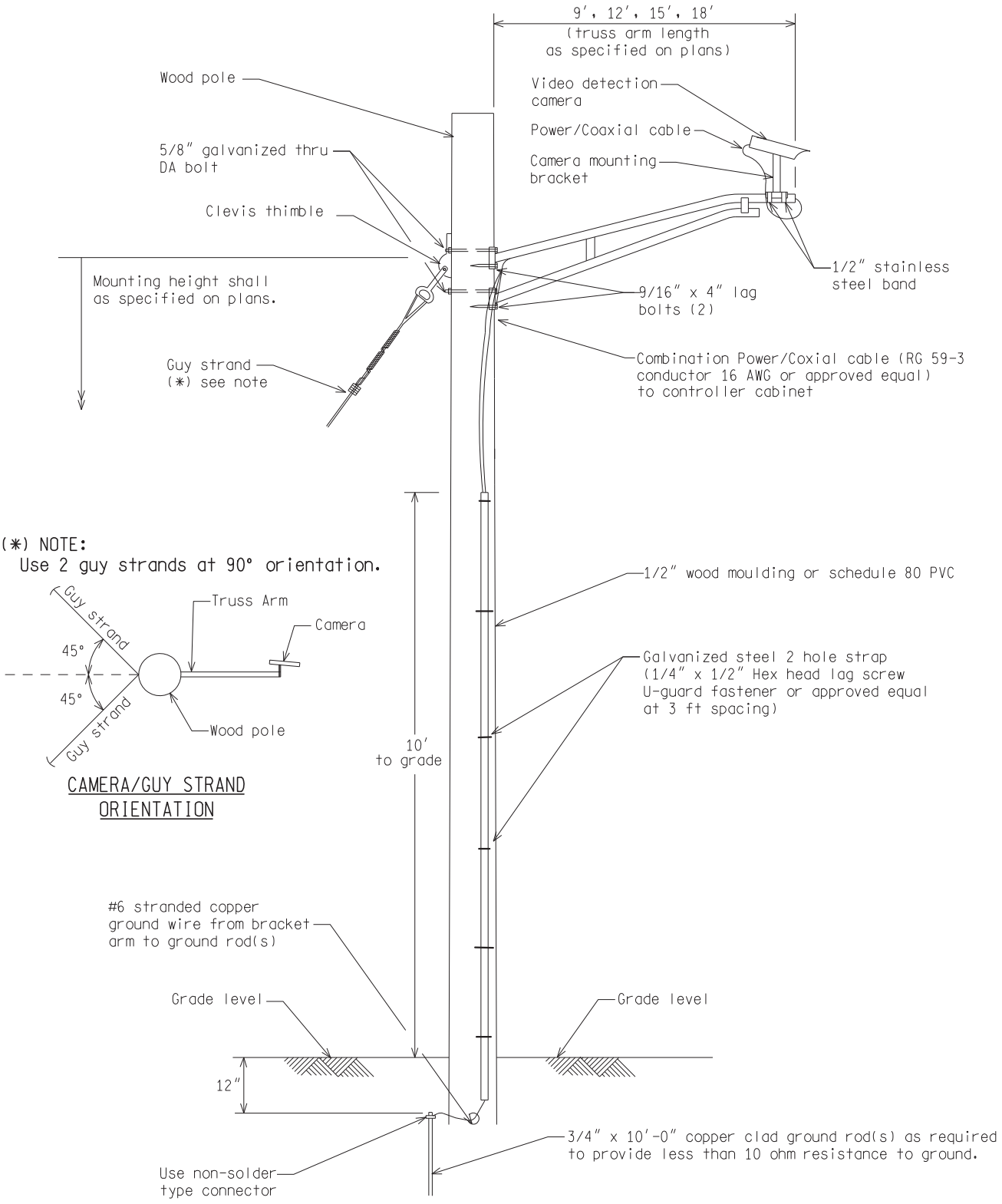


PUSHBUTTON & WOOD POST

** Refer to Standard Plan for Wood Posts

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-400-A	SHEET 4 of4
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG400A.dgn Rev. 02/16/17		PLAN DATE		



BRACKET TRUSS ARM MOUNTED CAMERA (WOOD POLE)

NOT TO SCALE

File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG430A.dgn Rev. 02/16/17

MDOT Michigan Department of Transportation

PREPARED BY
TRAFFIC AND SAFETY

DRAWN BY: DJF

CHECKED BY:

ENGINEER OF DELIVERY

ENGINEER OF DEVELOPMENT

(SPECIAL DETAIL)
FHWA APPROVAL DATE

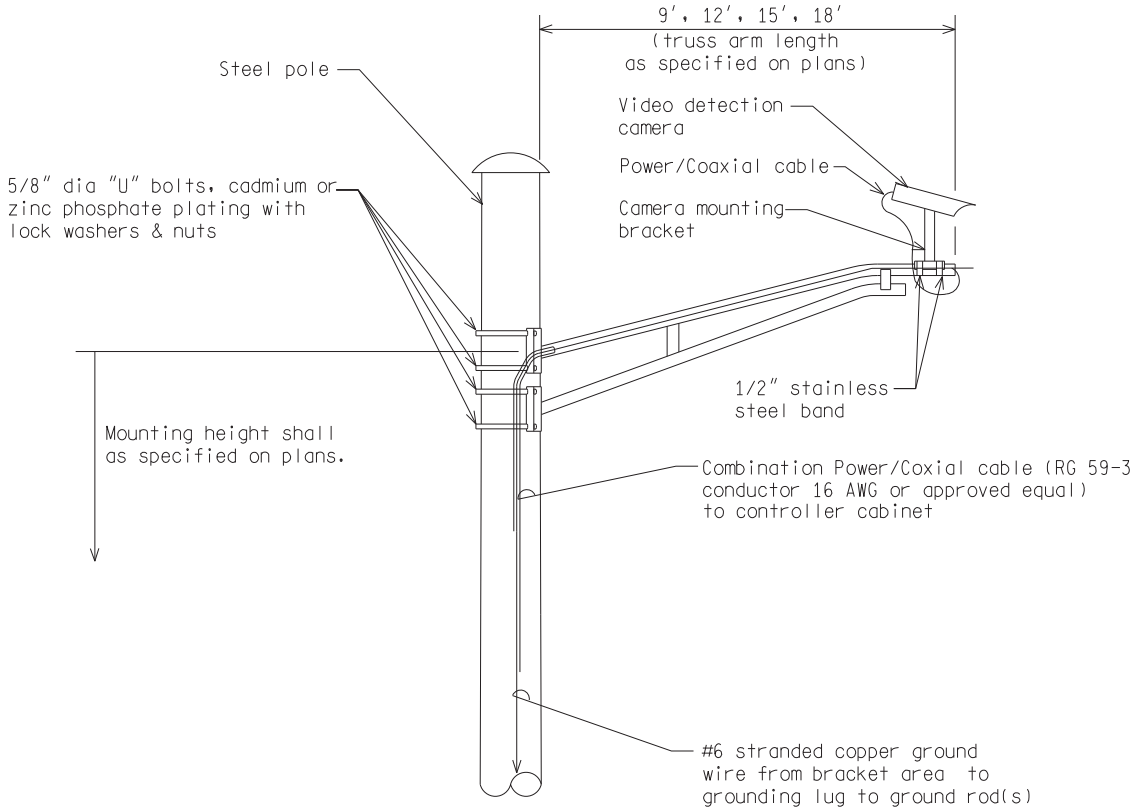
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN FOR

VIDEO DETECTION CAMERA

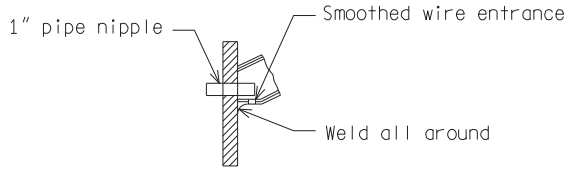
PLAN DATE

SIG-430-A

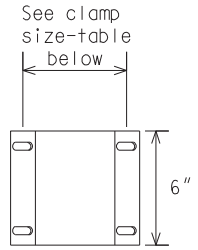
SHEET
1 of 2



BRACKET TRUSS ARM MOUNTED CAMERA (STEEL POLE)



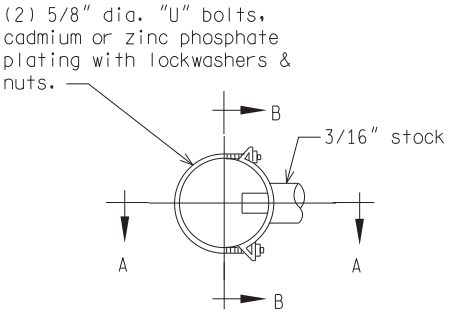
SECTION "A-A"



SECTION "B-B"

CLAMP SIZE TABLE

TYPE	POLE DIAMETER
A	3.6"- 4.5"
B	6.1"- 6.9"



DETAIL "F"

NOT TO SCALE

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS DELIVERY STANDARD PLAN	(SPECIAL DETAIL) FHWA APPROVAL DATE		SIG-430-A	SHEET 2 of 2
File: RefDoc/TR/Signals/Web/Sp Det/Fin/SIG430A.dgn Rev. 02/16/17		PLAN DATE		

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
CURB PAINTING

PMK:MKB 1 of 1 APPR:MWB:JLB:05-06-20

a. Description. This work consists of preparing the curb surface and applying pavement marking material to the top and/or face of the curb.

b. Materials. Select pavement marking material from the Qualified Products Lists, 811.03.

c. Construction. Prepare the curb surface as recommended by the manufacturer and apply pavement marking material to the top and/or face of curb as specified on the project plans or as directed by the Engineer. Remove curing compound on new concrete curbs. Complete the work in accordance with this special provision, the project plans, the standard specifications, and as directed by the Engineer.

Apply pavement marking material uniformly at the rates shown in Table 811-1 of the Standard Specifications for Construction. For materials not shown on this chart, use the specifications shown in the separate special provision for the material to be used, or the manufacturer's recommendations. Ensure curb markings are retro-reflective and have no visible drips.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	**Pay Unit**
Pavt Mrkg, (Material), __ inch, (color), Curb Painting	Foot

All curing compound removal required by this special provision will be paid for as Rem Curing Compound, for Spec Mrkg in accordance with section 811 of the Standard Specifications for Construction.

CITY OF KALAMAZOO

NOTICE TO BIDDERS

UTILITY COORDINATION

The Contractor shall cooperate and coordinate construction activities with the owners of utilities as stated in section 104.08 of the 2020 MDOT Standard Specifications for Construction. In addition, for the protection of underground utilities, the Contractor shall follow the requirements in Section 107.12 of the 2020 MDOT Standard Specifications for Construction. Contractor delay claims resulting from a utility, will be determined based upon Section 109.05 of the 2020 MDOT Standard Specifications for Construction.

For protection of underground utilities in conformance with Public Act 53, the Contractor shall dial 1-800-482-7171 or 811 a minimum of three (3) full working days, excluding Saturdays, Sundays and holidays, prior to beginning each excavation in areas where public utilities have not been previously located. Members will thus be routinely notified. This does not relieve the Contractor of the responsibility of notifying utility owners who may not be a part of the "MISS dig" alert system.

PUBLIC UTILITIES

The following Public Utilities have facilities located within the right-of-way.

Cable: Charter Communications, 4176 Commercial Avenue
Portage, MI 49002
(269) 459-8746, Mr. Bryan Longcore
Bryan.Longcore2@Charter.com

Comcast Cable Communications, 25626 Telegraph Road
Southfield, MI 480234
(734) 359-1669, Mr. Jeff Dobies
Jeff_Dobies@Cable.Comcast.Com

Electric: Consumers Energy, 2500 East Cork Street
Kalamazoo, MI 49001
(269) 337-2245, Mr. Andre Taylor
andre.taylor@cmsenergy.com

Consumers Energy, 2500 East Cork Street
Kalamazoo, MI 49001
(269) 337-2245, Mr. Ryan Walcott
ryan.walcott@cmsenergy.com

Gas: Consumers Energy, 2500 East Cork Street
Kalamazoo, MI 49001
(269) 337-2366, Mr. Kyle Oak
kyle.oak@cmsenergy.com

Telephone: AT&T, 2919 Millcork Street
Kalamazoo, MI 49001
(269) 823-3339, Mr. Phil Bardocz
Philip.D.Bardocz@att.com

Fiber Optic:	City of Kalamazoo, 415 Stockbridge Avenue Kalamazoo, MI 49001 (269) 337-8601, Mr. Ron Ridenour ridenourr@kalamazoocity.org
	Lumen, 19675 West 10 Mile Road Southfield, MI 48075 (517) 812-2592, Mr.Dave Huckfeldt Dave.Huckfeldt@Lumen.com
	Midwest Communications, 60590 Decatur Road Cassopolis, MI 49031 (269) 963-7173, Mr. Larry Powell LarryMCS@Voyager.net
	Zayo Fiber/MCI Fiber George Huss (443) 403-2023 George.Huss@Zayo.com
Traffic:	City of Kalamazoo, 415 Stockbridge Avenue Kalamazoo, MI 49001 (269) 337-8612, Mr Dennis Randolph, P.E., P.T.O.E. randolphd@kalamazoocity.org
Water:	City of Kalamazoo, 415 Stockbridge Avenue Kalamazoo, MI 49001 (269) 491-3882, Mr. Eric Sajtar sajtare@kalamazoocity.org
Sewer:	City of Kalamazoo, 1415 North Harrison Street Kalamazoo, MI 49007 (269) 337-8551, Mr. Sohil Manjiyani manjiyanis@kalamazoocity.org
Public Works:	City of Kalamazoo, 415 Stockbridge Avenue Kalamazoo, MI 49001 (269) 337-8601, Mr. Anthony Ladd ladda@kalamazoocity.org

The owners of existing service facilities that are within grading or structure limits will move them to locations designated by the Engineer or will remove them entirely from the highway right-of-way. Owners of the Public Utilities will not be required by the City to move additional poles or structures in order to facilitate the operation of construction equipment unless it is determined by the Engineer that such poles or structures constitute a hazard to the public or are extraordinarily dangerous to the Contractor’s operations.

No additional compensation will be paid to the CONTRACTOR for delays due to material shortages or other reasons beyond the control of the City of Kalamazoo, or for delays on construction due to the encountering of existing utilities that are, or are not, shown on the plans.

Work stoppages by employees of utility companies which results in a delay of utility revisions on any portion of this project may be considered the basis for a claim for an extension of time for completion but will not be considered the basis for a claim for extra compensation or an adjustment in contract unit prices.

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
SLOPE RESTORATION, NON-FREEWAY

RSD:NJM 1 of 5 APPR:DMG:JJG:04-05-23

a. Description. This work consists of preparing all lawns and slopes on non-freeway projects designated for slope restoration on the plans or as directed by the Engineer and applying topsoil, fertilizer, seed, mulch with mulch anchor, mulch blanket, high velocity mulch blanket, permanent turf reinforcement mat (TRM), bonded fiber matrix (BFM), or modified mulch blanket to those areas. Ensure turf establishment is in accordance with section 816 and 917 of the Standard Specifications for Construction and Standard Plan R-100 Series, except as modified herein or otherwise directed by the Engineer.

b. Materials. The materials, application rates, and construction methods specified in sections 816 and 917 of the Standard Specifications for Construction apply unless modified by this special provision or otherwise directed by the Engineer. Furnish the following materials on this project:

1. Seeding mixture as called for on the plans.

2. Chemical fertilizer nutrient, Class A.

3. Topsoil. The following percentages of furnished and salvaged topsoil are estimated for this project and provided for informational purposes only.

Topsoil Furnished: 30 percent
Topsoil Salvaged: 70 percent

4. Mulching material.

5. Permanent Turf Reinforcement Mat (TRM) must be 100 percent synthetic and consist of 100 percent ultraviolet (UV) stabilized polyolefin fibers sewn between two layers of black UV stabilized polypropylene netting with polyolefin thread. The TRM must meet the following "minimum average roll value" requirements:

Property	Test Method	Requirement
Mass/Unit Area	*ASTM D6566*	10 oz/syd
UV Stability @ 1000 hrs	*ASTM D4355/D4355M*	80 percent
Tensile Strength (MD)	*ASTM D6818*	165 lbs/ft

Acceptance. Supply a general certification for the permanent TRM from one of the following manufacturers or approved equal:

Recyclex TRM	American Excelsior Co., Arlington, TX	(800) 777-7645
P300 TRM	North American Green, Poseyville, IN	(800) 772-2040
Landlok 450 TRM	Propex, Inc., Chattanooga, TN	(800) 621-1273

Excel PP5-10 TRM	Western Excelsior, Evansville, IN	(866) 540-9810
Vmax P550 TRM	North American Green, Poseyville, IN	(800) 772-2040

6. Bonded Fiber Matrix (BFM). Furnish a product from the list below or an approved equal.

Soil Guard	Mat Inc., Floodwood, MN	(888) 477-3028
HydroStraw BFM	HydroStraw, LLC, Rockford, WA	(800) 545-1755
HydraMax	North American Green, Poseyville, IN	(800) 772-2040
Bindex BFM	American Excelsior Co., Arlington, TX	(800) 777-7645
ProMatrix EFM	Profile Products LLC, Buffalo Grove, IN	(800) 508-8681

If multiple grades of the selected product are available, use the grade appropriate for the application as approved by the Engineer.

Approved equal BFM must consist of long strand, virgin wood fibers (90 percent by weight) bound together by a pre-blended, high-strength polymer adhesive (10 percent by weight). The virgin wood fibers will be thermally refined from clean whole wood chips. Ensure the organic binders are a high-viscosity colloidal polysaccharide tackifier with activating agents to render the resulting matrix insoluble upon drying.

7. Modified Mulch Blanket. Where modified mulch blanket is required, provide an excelsior mulch blanket free of chemical additives. Ensure the netting thread is 100 percent biodegradable and manufactured with non-plastic materials such as jute, sisal, or coir fiber. Degradable, photodegradable, UV-degradable, oxo-degradable, or oxo-biodegradable plastic netting including polypropylene, nylon, polyethylene, and polyester is not an acceptable alternative. All netting materials must have a loose weave design with movable junctions between the machine and cross-machine direction twines that move independently and reduce the potential for wildlife entanglement.

For Slope Restoration, Non-Freeway, Type F, provide a single net modified mulch blanket from the list below or an approved equal.

Premier Straw Single Net FibreNet	American Excelsior Co.	(800) 777-7645
Curlex NetFree 100% Biodegradable	American Excelsior Co.	(800) 777-7645
ECS-1B Biodegradable Single Straw	East Coast Erosion Control	(800) 582-4005
S1000BD Single Net	Enviroscape ECM, Ltd.	(888) 550-1999
Excel SR-1 All Natural	Western Excelsior Corp.	(866) 540-9810

For Slope Restoration, Non-Freeway, Type G, provide a double net modified mulch blanket from the list below or an approved equal.

Premier Straw Double Net FibreNet	American Excelsior Co.	(800) 777-7645
Curlex II FibreNet	American Excelsior Co.	(800) 777-7645
ECX-2B Double Net Biodegradable	East Coast Erosion Control	(800) 582-4005
S2000BD Double Net	Enviroscape ECM, Ltd.	(888) 550-1999
Excel R-2 All Natural	Western Excelsior Corp.	(866) 540-9810

c. Construction. Ensure construction methods are in accordance with subsection 816.03 of the Standard Specifications for Construction. Begin this work as soon as possible after final grading of the areas designated for slope restoration but no later than the maximum time frames

specified in subsection 208.03 of the Standard Specifications for Construction. It may be necessary, as directed by the Engineer, to place materials by hand.

Shape, compact, and ensure all areas to be seeded are weed-free prior to placing topsoil. Place topsoil to the minimum depth as detailed herein and in accordance with the plans and standard specifications to meet proposed finished grade. If the area being restored requires more than the minimum depth of topsoil to meet finished grade, fill this additional depth using topsoil or, at the Contractor's option, embankment. Furnishing and placing this additional material is included in this item of work.

Ensure topsoil is weed and weed seed free and friable prior to placing seed. Remove any stones greater than 1/2-inch in diameter or other debris. Apply seed mixture and fertilizer to prepared soil surface. Incorporate seed into top 1/2-inch of topsoil.

Spread mulch at a rate of two tons per acre. If the Engineer allows dormant seeding spread mulch at a rate of 3 tons per acre. Place mulch anchoring over the mulch at a rate in accordance with subsection 816.03.F of the Standard Specifications for Construction. Place mulch blanket and high-velocity mulch blanket in accordance with subsection 816.03.G of the Standard Specifications for Construction and Standard Plan R-100 Series.

Install areas constructed with the TRM on prepared (seeded) grades as shown on the plans in accordance with the manufacturer's published installation guidelines. Anchor the top edge of the TRM in a minimum six-inch deep trench. Operation of equipment on the slope is prohibited after placement of the TRM. No credit for splices, overlaps, tucks, or wasted material will be made.

Mix the BFM and organic binders thoroughly at a rate of 40 pounds for each 100 gallons of water or as otherwise recommended by the manufacturer. Hydraulically apply the BFM slurry in successive layers, from two or more directions, to fully cover 100 percent of the soil surface. Ensure the minimum application rate is at least 3000 pounds of BFM for each acre or otherwise apply in accordance with the manufacturer's recommendations as appropriate depending on site conditions.

Do not apply BFM on saturated soils or immediately before, during, or after rainfall.

Install modified mulch blanket in accordance with the manufacturer's published guidelines and as directed by the Engineer.

If an area washes out after this work has been properly completed and approved by the Engineer, make the required corrections to prevent future washouts and replace the topsoil, fertilizer, seed, and mulch treatment. This replacement will be paid for as additional work using the applicable pay items.

If an area washes out for reasons attributable to the Contractor's activity or failure to take proper precautions, replacement will be at no cost to the contract.

The Engineer will inspect the seeded turf to ensure it is well-established, in a vigorous growing condition, and contains the species called for in the seeding mixture.

If the seeded turf is not well-established at the end of the first growing season, the Contractor is responsible to re-seed until the turf is well established and approved by the Engineer.

Provide weed control, if weeds are determined by the Engineer to cover more than 10 percent of the total area of slope restoration, in accordance with subsection 816.03.I of the Standard Specifications for Construction. Weed control will be at no additional cost to the contract.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Slope Restoration, Non-Freeway, Type __	Square Yard

1. Place **Slope Restoration, Non-Freeway, Type A** in all areas not described in the other types of slope restoration and will be measured by area in square yards in place. **Slope Restoration, Non-Freeway, Type A** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; Mulch; and Mulch Anchoring.

2. Place **Slope Restoration, Non-Freeway, Type B** parallel (8 feet minimum) to the edge of the roadway, in areas that have a 1 on 3 slope and in any ditch with a grade less than 1.5 percent, as shown on the plans, or as directed by the Engineer. **Slope Restoration, Non-Freeway, Type B** will be measured by area in square yards in place. **Slope Restoration, Non-Freeway, Type B** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and Mulch Blanket.

3. Place **Slope Restoration, Non-Freeway, Type C** in areas that have a 1 on 2 slope, any ditch with a grade of 1.5 percent to 3 percent as shown on the plans, or as directed by the Engineer. **Slope Restoration, Non-Freeway, Type C** will be measured by area in square yards in place. **Slope Restoration, Non-Freeway, Type C** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and Mulch Blanket, High Velocity.

4. Place **Slope Restoration, Non-Freeway, Type D** in areas that have a slope steeper than 1 on 2, any ditch with a grade steeper than 3 percent as shown on the plans, or as directed by the Engineer. **Slope Restoration, Non-Freeway, Type D** will be measured by area in square yards in place. **Slope Restoration, Non-Freeway, Type D** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and Turf Reinforcement Mat.

5. Place **Slope Restoration, Non-Freeway, Type E** as shown on the plans, or as directed by the Engineer and measured by area in square yards in place. **Slope Restoration, Non-Freeway, Type E** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and Bonded Fiber Matrix.

6. Place **Slope Restoration, Non-Freeway, Type F** parallel (8 feet minimum) to the edge of the roadway, in areas that have a 1 on 3 slope and in any ditch with a grade less than 1.5 percent. **Slope Restoration, Non-Freeway, Type F** includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and single net modified Mulch Blanket.

7. Place **Slope Restoration, Non-Freeway, Type G** in areas that have a 1 on 2 slope and in any ditch with a grade of 1.5 percent to 3 percent. **Slope Restoration, Non-Freeway,**

Type G includes installing Topsoil Surface, Furn, LM or Topsoil Surface, Salv, 4 inch; Fertilizer, Chemical Nutrient, Class A; seeding mixture; and double net modified Mulch Blanket.

CITY OF KALAMAZOO

SPECIAL PROVISION

FOR

MAINTAINING TRAFFIC

a. Description. This work consists of all labor, materials, and equipment required for maintaining traffic in accordance with this special provision for water main replacement, storm sewer improvements, road reconstruction and rehabilitation and conversion from one-way to two-way traffic on W Main Street, W Michigan Avenue and Michikal Street in the City of Kalamazoo, Kalamazoo County.

b. General. Maintain traffic according to Sections 104.11, 812 and 922 of the Michigan Department of Transportation *2020 Standard Specifications for Construction*, the Michigan Manual of Uniform Traffic Control Devices (MMUTCD), including any Supplemental Specifications, and as specified herein.

1. The Contractor shall notify the Engineer, the City of Kalamazoo, local police department, local fire department, and other emergency response units a ***minimum of 10 business days*** prior to the implementation of any detours, road closures, bridge closures, ramp closures or lane closures, and major traffic shifts.

2. Coordinate operations with Contractors performing work on other projects within or adjacent to the Construction Influence Area (CIA) as described below. The Contract Maintenance Agency will coordinate their operations with the Engineer to minimize the interference with the Contractor. No additional payment will be made to the Contractor for the joint use of the traffic control items.

3. During all times of construction, access to local businesses and drives for emergency vehicles shall be maintained by the Contractor until the project is completed unless a temporary closure is approved in writing by the Engineer. This work will not be considered for additional payment but shall be included in the payment for Minor Traf Devices.

4. The Contractor shall conduct their work in such a manner so no excavations are left open overnight. If this is not possible, the Contractor shall provide and install a temporary fence to protect the excavation at their own expense. Whenever possible, the Contractor shall use a trench box and backfill all excavations and/or trenches and cover or protect the trench box at the end of each work day. No excavations and/or trenches are to be left open overnight unless a full closure is in place. Payment for this work shall be included in Minor Traf Devices.

5. Coordinate all lane or road closures with Kalamazoo Metro Transit to maintain access or provide alternate access for any bus stops within the CIA.

6. The Contractor shall coordinate all signal modifications, temporary signals, signal bagging and un-bagging and traffic shifts with the City of Kalamazoo Traffic Engineer so that appropriate signal timing and camera adjustments can be completed. The Contractor

shall notify the City of Kalamazoo a ***minimum of 10 business days*** prior to implementing traffic shifts requiring traffic signal modifications.

c. Relations and Responsibility to the Public.

1. Notification shall be provided to residents/businesses directly affected by the proposed work via door hanger notices no less than 72 hours before the portion of the road where their property is located is planned to receive work. The Contractor will provide a pre-printed door hanger to carry the Contractor's message to the residents/businesses. Message content must be approved by the Engineer prior to printing and distribution. The responsibility for filling out the door hangers and distributing them will be the Contractor's. Payment for this work will be paid separately, but payment will be included in the item for Minor Traf Devices. No work shall be performed in each section of the project prior to the affected residents/businesses have been notified via distribution of door hangers.

2. 24 hours before every construction operation that will substantially affect a resident or business adjacent to the project site, (such as driveway closures, mailbox relocation, etc.) the Contractor will notify affected residents or businesses. The Contractor shall assist the Engineer and/or Owner in coordinating work and mitigating impacts to the extent possible while maintaining construction schedules.

d. Construction Influence Area (CIA). The CIA includes the right-of-way of the following roadways, within the approximate limits described below:

1. W Main Street from Stuart Avenue to the W Main Street / W Michigan Avenue / Michikal Street Intersection.

2. W Michigan Avenue from W South Street to Allen Blvd.

3. Michikal Street from the W Main Street, W Michigan Avenue / Michikal Street intersection to the W Kalamazoo Avenue / N Westendge Avenue / Michikal Street intersection.

4. N Westnedge Avenue from Willard Street to Eleanor Street.

5. W Kalamazoo Avenue from N Park Street to Greenwich Place.

6. In addition, the CIA shall include the rights-of-way of any intersecting roads adjacent to the work zone for a distance of approximately 500 feet in advance of the roads listed above. The roads include:

   Stuart Avenue, Catherine Street, Woodward Avenue, Elm Street, Academy Street, Elm Crossover, Allen Blvd., Elm Place, Eleanor Street, Old Orchard Place.

7. Include in the CIA shall include the rights-of-way of any intersecting roads and ramps adjacent to the work zone for the distance noted in the signing standards.

8. Include in the CIA the rights-of-way of any signed detour routes.

e. Traffic Restrictions.

1. No work shall be performed during the Memorial Day, Independence Day, Labor Day holiday periods, as defined by the Engineer.

2. All work shall be done between the hours of 7 a.m. to 7 p.m. (Monday – Saturday) unless otherwise specified herein. Work done outside of the times specified herein will be at the discretion of the Engineer and any additional cost for maintaining traffic shall be borne by the Contractor.

3. No work shall be done on Sunday unless otherwise specified herein or approved by the Engineer in writing. The Contractor shall request permission to work no later than 12:00 p.m. the Wednesday prior to the weekend they are requesting to work.

4. The arrow board, signs, and channelizing tapers for any flag control operations shall be placed at locations approved by the Engineer for adequate visibility to oncoming traffic.

5. The minimum lane width throughout the CIA shall be 10 feet.

6. Maintain access to commercial and residential properties at all times. Part-width driveway construction will be required. All driveway closures must be approved by the Engineer. Where a driveway is closed or partially closed, the adjacent driveway must remain open to traffic. The Contractor shall coordinate their work with the impacted property owners and give a minimum of 3 days' notice prior to closing a driveway.

7. Utilize intermediate traffic regulators during the reconstruction of driveways with commercial traffic. The cost of all required traffic regulators is included in the payment for Traffic Regulator Control.

8. Maintain access for pedestrians to all commercial and residential properties.

9. Cover all existing regulatory, warning, and construction signs that are not applicable during construction.

10. The Contractor must submit a work zone traffic control plan to the Engineer in accordance with section 104 of the 2020 MDOT Standard Specifications for Construction. The Engineer will have seven (7) calendar days to review the plan for acceptance or provide comments for plan revisions required to obtain acceptance. At a minimum, the plan shall include the proposed ingress/egress locations for construction equipment and vehicles, traffic control devices that will be utilized to warn the motoring public of ingress/egress locations, and measures that will be taken to ensure compliance with the plan as specified herein. No work shall begin prior to acceptance of the work zone traffic control plan. Additional time required to obtain an accepted work zone traffic control plan shall not be cause for delay or impact claims. All costs associated with obtaining an acceptable plan, providing and executing all parts of the accepted plan including required traffic control devices, or resolving an incomplete or unacceptable plan shall be borne by the Contractor.

11. The Contractor shall comply with local noise ordinances, which are available on the City of Kalamazoo's website, except for any night work specified herein.

12. Traffic signal work may deviate from the phasing and seasonal limitations described herein subject to approval by the Engineer.

f. Traffic Control. The traffic control required by this Special Provision for work on W Main Street, W Michigan Avenue and Michikal Street and adjacent roadways is to erect and maintain signs for through traffic when specified. Maintain local traffic as provided herein. An alternate traffic control plan may be used by the Contractor, subject to review and approval by both the Engineer and the City of Kalamazoo. The Contractor shall provide access to all properties within the Construction Zone for the duration of the project.

The proposed staging is to consist of three (3) phases. Phase I and Phase II described in this Special Provision is depicted on plan sheets C037-C042. Phase III will be for top course HMA paving and will utilize portions of traffic control from Phase I and Phase II and traffic regulator control as necessary.

Phase I: This phase is for contract work on Michikal Street from the W Main Street / W Michigan Avenue / Michikal Street intersection to the W Kalamazoo Avenue / N Westnedge Avenue / Michikal Street intersection.

Work included in Phase I:

1. Realignment and full reconstruction of the existing roadway including removal of existing concrete curb & gutter, concrete pavement and HMA / concrete pedestrian facilities, grading and installation of new concrete curb & gutter, sand subbase, aggregate base and HMA pavement.
2. Storm sewer improvements.
3. Construction of new pedestrian facilities such as concrete sidewalk and shared use path.
4. Pavement markings, permanent signage, restoration and landscaping.

Michikal Street will be closed to all traffic during all contractor work in this phase. Implement two (2) detour routes for Michikal Street as depicted on sheet C037 of the plans. The first detour route will be for southbound traffic on N Westnedge Avenue and westbound traffic on Kalamazoo Avenue. This detour route will utilize Kalamazoo Avenue, Douglas Avenue and W Main Street. As part of the Michikal Street closure, northbound traffic on W Michigan Avenue will not be permitted to use Allen Boulevard, Elm Place, Elm Crossover or Elm Street to access the Stuart neighborhood. The second detour route for this traffic movement using W Michigan Avenue, N Park Street and W Kalamazoo Avenue as depicted on sheet C037 of the plans. Phase I work will be considered complete when:

1. Michikal Street reconstruction is complete including top course HMA pavement, permanent signs and pavement markings to accommodate two-way traffic.
2. Storm sewer improvements within the Phase I work zone are complete.
3. Construction of new pedestrian facilities within the Phase I work zone is complete.
4. All proposed restoration and landscaping on Michikal Street has been installed.
5. Eleanor Street / Old Orchard Place, Allen Blvd., and Elm Place intersections have been fully realigned and reconstructed including top course HMA pavement, and have been connected into the new Michikal Street as shown on the plans.
6. Michikal Street temporary connections to W Kalamazoo Avenue / N Westnedge Avenue is complete.

Phase I work may be constructed concurrently with other phases. After Phase I construction work is completed, traffic control will remain in place and Michikal Street will remain closed. This configuration will remain in place until after Phase II construction is completed.

Phase II: This phase is for contract work at the intersection W Michigan Avenue, W Main Street and Michikal Street.

Work included in Phase II:

1. Realignment and full reconstruction of the existing roadway including removal of existing concrete curb & gutter, concrete pavement and HMA / concrete pedestrian facilities, grading and installation of new concrete curb & gutter, sand subbase, aggregate base and HMA pavement.
2. Storm sewer improvements.
3. Installation of new 16” ductile iron water main and copper water services.
4. Construction of new concrete sidewalk and ADA ramps.
5. Installation of new traffic and pedestrian signals.
6. Pavement markings, permanent signage, and restoration.

Phase II has been broken down into three (3) sub-phases, Phase IIA, IIB, and IIC. Michikal Street will remain closed to all traffic during all contractor work in this phase. Implement three (3) detour routes for Michikal Street as depicted on sheet C040 of the plans. The first two detour routes are the same detour routes posted in Phase I and should remain in place for the duration of Phase II. The third detour route will be a second option for westbound traffic on Kalamazoo Avenue and southbound traffic on N Westnedge Avenue and will utilize N Westnedge Avenue and Lovell Street. All three (3) proposed detour routes for Phase II are depicted on sheet C040 of the plans.

Phase two (2A): Prior to setting traffic control and beginning work on Phase IIA, the contractor shall remove and replace a portion of the existing raised center median on W Michigan Avenue between Academy Street and the W Main Street / W Michigan Avenue / Michikal Street intersection as noted on sheet C041 of the plans. The contractor shall utilize the traffic control devices on site from Phase I construction including advanced warning signs, channelizing devices, lighted arrow boards and barricades to set up and maintain single lane closures on W Michigan Avenue between Academy Street and the W Main Street / W Michigan Avenue / Michikal Street intersection as needed to complete this work. The existing raised center median shall be sawcut and removed to full depth and replaced with temporary HMA as directed by the Engineer. This temporary work must be completed to the satisfaction of the Engineer prior to beginning Phase IIA.

Work included in Phase IIA:

1. Realignment and full reconstruction of the southeast quadrant of the intersection.
2. Removal of existing concrete curb & gutter, concrete pavement and HMA / concrete pedestrian facilities, grading and installation of new concrete curb & gutter, sand subbase and aggregate base within the limits described above.
3. Storm sewer improvements.
4. Installation of new 16” ductile iron water main and water services.
5. Construction of new concrete sidewalk and ADA ramps.
6. HMA paving through the leveling course.

7. Installation of new traffic and pedestrian signal infrastructure.
8. Permanent signage and restoration.

Michikal Street will be closed to all traffic during all contractor work in this phase. Shift traffic into one lane eastbound on W Main Street. Traffic should be in the northernmost lane on W Main Street prior to reaching the Amtrak Railroad crossing. Once W Main Street traffic reaches Elm Street, a right turn only lane will open for traffic turning onto W Michigan Avenue southwestbound. One lane of eastbound traffic will be maintained through the intersection (northernmost of the two lanes) for traffic continuing onto W Michigan Avenue eastbound. One lane of southbound traffic on W Michigan Avenue will be maintained in the westernmost lane until outside of the construction zone. The end of the construction zone is considered to be the Academy Street intersection. Northbound traffic on W Michigan Avenue should be shifted into one lane prior to reaching Academy Street. Traffic will further be shifted to the west side of the roadway directly adjacent to southbound traffic. This shift will occur between Academy Street and the intersection under construction. Northbound traffic will be allowed to continue only onto eastbound W Michigan Avenue. Phase IIA maintaining traffic plan is depicted on sheet C041 of the plans.

Phase IIA work will be considered complete when:

1. All removals within the Phase IIA work zone are completed as shown on the plans or as directed by the Engineer in the field.
2. Concrete curb and gutter installation and subbase, aggregate base installation within the Phase IIA work zone is complete.
3. HMA pavement has been installed through the leveling course within the Phase IIA work zone.
4. Storm sewer improvements within the Phase IIA work zone are complete.
5. Water Main installation within the Phase IIA work zone is complete, including water service installation and connection to the existing mains on W Michigan Avenue.
6. Construction of new pedestrian facilities within the Phase IIA work zone is complete.
7. Restoration within the Phase IIA work zone is complete.

Phase IIA may be completed concurrently with Phase I and before both Phase IIB and Phase IIC.

Phase IIB:

Work included in Phase IIB:

1. Realignment and full reconstruction of the southwest quadrant of the intersection.
2. Removal of existing concrete curb & gutter, concrete pavement and HMA / concrete pedestrian facilities, grading and installation of new concrete curb & gutter, sand subbase and aggregate base within the limits described above.
3. Storm sewer improvements.
4. Installation of new 16” ductile iron water main.
5. Construction of new concrete sidewalk and ADA ramps.
6. HMA paving through the leveling course.
7. Installation of new traffic and pedestrian signal infrastructure.
8. Permanent signage and restoration.

Michikal Street will be closed to all traffic during all contractor work in this phase. Leave traffic on W Main Street in Phase IIA configuration. One lane of southbound traffic and one lane of northbound traffic will be maintained on W Michigan Avenue. W Michigan Avenue traffic lanes shall be maintained on leveling course HMA pavement installed in Phase IIA. Northbound traffic on W Michigan Avenue should be shifted into one lane prior to reaching Academy Street. Traffic will be maintained in one lane (easternmost lane) adjacent to new curb and gutter from Academy Street to the intersection under construction. Northbound traffic will be allowed to continue only onto eastbound W Michigan Avenue. Southbound traffic will be maintained in a single lane adjacent to northbound traffic and will be shifted back to the westerly side of the roadway through the Academy Street intersection with the use of temporary pavement markings. Phase IIB maintaining traffic plan is depicted on sheet C041 of the plans.

Phase IIB work will be considered complete when:

1. All removals within the Phase IIB work zone are completed as shown on the plans or as directed by the Engineer in the field.
2. Concrete curb and gutter installation and subbase, aggregate base installation within the Phase IIB work zone is complete.
3. HMA pavement has been installed through the leveling course within the Phase IIB work zone.
4. Storm sewer improvements within the Phase IIB work zone are complete.
5. Water Main installation within the Phase IIB work zone is complete, including connections to the existing mains one W Main Street, side street connection at Elm Street, and connection to the existing main serving Walgreens.
6. Construction of new pedestrian facilities within the Phase IIB work zone is complete.
7. Restoration within the Phase IIB work zone is complete.

Phase IIB may be completed concurrently with Phase I, after Phase IIA, and before Phase IIC.

Phase IIC:

Work included in Phase IIC:

1. Realignment and full reconstruction of the northern half of the intersection from W Main Street P.O.B. near Elm Street to W Michigan Avenue P.O.E. east of the intersection. Includes reconstruction and realignment of Elm Street approach. Includes connection to Michikal Street as reconstructed in Phase I.
2. Removal of existing concrete curb & gutter, concrete pavement and HMA / concrete pedestrian facilities, grading and installation of new concrete curb & gutter, sand subbase and aggregate base within the limits described above.
3. Storm sewer improvements.
4. Construction of new concrete sidewalk and ADA ramps.
5. HMA paving through the leveling course.
6. Installation of new traffic and pedestrian signal infrastructure.
7. Permanent signage and restoration.

Michikal Street will be closed to all traffic during all contractor work in this phase. Shift traffic into a single lane eastbound on W Main Street. Traffic should be into the northernmost 10’ of the southernmost lane on W Main Street prior to reaching the Amtrak Railroad crossing. Once W Main Street traffic passes the Walgreen driveway, a right turn only lane will open for traffic

turning onto W Michigan Avenue southwestbound. One lane of eastbound traffic will be maintained through the intersection (northernmost of the two lanes) for traffic continuing onto W Michigan Avenue eastbound. Southbound traffic on W Michigan Avenue will be maintained in a single lane adjacent to the new curb line constructed in Phase IIB. Southbound traffic on W Michigan Avenue shall remain in this lane configuration until out of the construction zone (past the Academy Street intersection). One lane of northbound traffic will be maintained on W Michigan Avenue. Northbound traffic on W Michigan Avenue should be shifted into a single lane prior to reaching the Academy Street intersection. Northbound traffic will be maintained in the same lane as in Phase IIB and will only be permitted to turn right and continue eastbound on W Michigan Avenue once reaching the intersection under construction. Phase IIC maintaining traffic plan is depicted on sheet C042 of the plans.

Phase IIC work will be considered complete when:

1. All removals within the Phase IIC work zone are completed as shown on the plans or as directed by the Engineer in the field.
2. Concrete curb and gutter installation and subbase, aggregate base installation within the Phase IIC work zone is complete.
3. HMA pavement has been installed through the leveling course within the Phase IIC work zone.
4. Storm sewer improvements within the Phase IIC work zone are complete.
5. Construction of new pedestrian facilities within the Phase IIC work zone is complete.
6. Restoration within the Phase IIC work zone is complete.

Phase IIC may be completed concurrently with Phase I and after both Phase IIA and Phase IIB.

Phase III: This phase is for top course HMA paving at the intersection W Michigan Avenue, W Main Street and Michikal Street. Phase III will also include finalization and switchover to operation of new traffic signal at the intersection and project cleanup.

Work included in Phase III:

1. Top course HMA paving at the intersection of W Michigan Avenue, W Main Street and Michikal Street (Phase IIA, Phase IIB and Phase IIC work zones).
2. Pavement markings.
3. Switchover to new traffic signal operation.

Utilize traffic configurations as shown in Phase IIA, Phase IIB, Phase IIC and traffic regulator control as needed to complete HMA top course paving within the limits described above.

Phase III work will be considered complete when:

1. Top course HMA paving is completed within the limits described above.
2. Pavement marking installation is complete within the limits described above.
3. New traffic signal is fully operational.
4. All temporary traffic control devices have been removed for the new roadway.

g. Pedestrian or Non-Motorized Facilities.

1. Maintain all facilities in accordance with *The Americans with Disability Act* (ADA) requirements. Provide facilities equivalent to or better than the route a person would have encountered prior to construction activities.

2. Close and detour any sidewalk ramps and crosswalk areas to pedestrian traffic that are impacted by the work as described below. Cover pedestrian signal heads when the crosswalk or ramp is affected.

3. Keep sidewalk areas clear of any equipment or materials at all times the sidewalks are open to pedestrian traffic.

There are three (3) proposed pedestrian detour routes included with this project to be implemented and maintained. They are as follows:

Phase I: Phase I pedestrian detour corresponds to Phase I construction (reconstruction of Michikal Street) and the Phase I maintenance of traffic plan as described in this special provision and as shown on sheets C037-C039 of the plans. Phase I pedestrian detour as described in this special provision is depicted on sheet C043 of the plans.

The existing HMA shared use path along the easterly side of Michikal Street will be closed during Phase I construction. Close the existing path at the intersection of Michikal Street and N Wesnedge Avenue and at the intersection of W Main Street / W Michigan Avenue / Michikal Street. Implement a detour route using the north side of W Michigan Avenue and the west side of N Westnedge Avenue. Furnish, erect and maintain temporary signage and pedestrian barricades for this detour route as shown on sheet C043 of the plans.

Phase IIA: Phase IIA pedestrian detour corresponds to Phase IIA and Phase IIB construction (reconstruction of the southern half of the W Main Street / W Michigan Avenue / Michikal Street intersection) and the Phase IIA and Phase IIB maintenance of traffic plans as described in this special provision and as shown on sheets C040 – C041 of the plans. Phase IIA pedestrian detour as described in this special provision is depicted on sheet C044 of the plans.

The existing sidewalk on the southerly half of the intersection under construction will be closed during this phase as well as sidewalk on both sides of W Michigan Avenue from Academy Street to the intersection. Implement a detour route using the north side of W Main Street and W Michigan Avenue, west side of N Westnedge Avenue and the north side of Academy Street. Furnish, erect and maintain temporary signage and pedestrian barricades for this detour route as shown on sheet C044 of the plans.

Phase IIB: Phase IIB pedestrian detour corresponds to Phase IIC construction (reconstruction of the northern half of the W Main Street / W Michigan Avenue / Michikal Street intersection) and the Phase IIC maintenance of traffic plan as described in this special provision and as shown on sheet C042 of the plans. Phase IIB pedestrian detour as described in this special provision is depicted on sheet C045 of the plans.

The existing sidewalk on the northerly half of the intersection under construction will be closed during this phase. Implement a detour route using the north side of W Main Street and W Michigan Avenue and west side of N Westnedge Avenue. Furnish, erect and maintain temporary signage and pedestrian barricades for this detour route as shown on sheet C045 of the plans.

h. Traffic Control Devices

1. *General.* Conform all traffic control devices and their usage to Part 6 of the Michigan Manual on Uniform Traffic Control Devices (MMUTCD). This document can be found at the following website:

   http://mdotjboss.state.mi.us/TSSD/tssdHome.htm

   a. During construction, maintain access to all business and residential drives.

2. Temporary Signs

   a. Place temporary sign spacing and taper lengths as shown on the attached Typical 101-GEN-SPACING-CHARTS.

   b. Utilize MDOT Typical 102-GEN-NOTES if called for on the MDOT Maintaining Traffic Typicals included in the Special Provision.

   c. Utilize signs identified in the MDOT Maintaining Traffic Typical 103-GEN-SIGN unless otherwise specified on the plans or in this Special Provision.

   d. Place temporary advance signing treatment and signing for lane closures and lane shifts on the project as shown on the attached MDOT Typicals: 123-NFW-1LC-(R); 126-NFW-2LC-(R).

   e. Fabricate all temporary signs with legends and symbols flush to the sign's face and do not extend beyond the sign borders or edges.

   f. Mount all temporary signs that will be in place for more than 14 days on driven posts.

   g. When a portable construction sign is no longer applicable, remove it or lay the sign down with legs pointed in the same direction as traffic flow, with its feet off and laid flat.

3. Temporary Pavement Markings

   a. Temporary pavement markings consist of the following:

      Pavt Mrkg, Wet Reflective, Type NR, Paint, 4 inch, White, Temp
      Pavt Mrkg, Wet Reflective, Type NR, Paint, 4 inch, Yellow, Temp
      Pavt Mrkg, Wet Reflective, Type R, Tape, 4 inch, White, Temp
      Pavt Mrkg, Wet Reflective, Type R, Tape, 4 inch, White, Temp
      Pavt Mrkg, Type NR, Paint, 24 inch, Stop Bar
      Pavt Mrkg, Type NR, Paint, Lt Turn Arrow
      Pavt Mrkg, Type NR, Paint, Rt Turn Arrow
      Pavt Mrkg, Type NR, Paint, Thru Arrow

   b. **Pavt Mrkg, Wet Reflective, Type NR, Paint, 4 inch, _____, Temp** and **Pavt Mrkg, Type NR, Paint _____** shall be placed on pavement areas that

will be removed or covered during construction for interim traffic control at locations specified by the Engineer.

c. **Pavt Mrkg, Wet Reflective, Type R, Tape, 4 inch, _____, Temp** shall be placed on pavement areas that **will not** be removed or covered during construction for interim traffic control at locations specified by the Engineer.

4. Channelizing Devices

    a. Channelizing devices required shall be **Channelizing Device, 42 inch, Flourescent, Furn**.

5. Plastic Drums

    a. Plastic Drums required shall be **Plastic Drum, Flourescent, Furn**.

6. Lighted Arrows

    a. **Lighted Arrow, Type C, Furn** shall be used whenever closing a traffic lane or shoulder and as called for on the traffic control plans.

    b. The quantity of channelizing devices required for the lighted arrows are already included in the quantity for **Channelizing Device, 42 inch, Flourescent, Furn**.

7. Portable Changeable Message Sign

    a. PCMS shall be furnished to the site 2 weeks prior to commencement of construction at locations agreed upon by the Engineer.

    b. Contractor shall verify the message with the Engineer and change as directed per current operations in a timely manner.
        i. Acceptable Messages:
            1. Michikal Street Closed Beginning X-XX-XX
            2. Road Closed Ahead – Michikal Street

    c. The quantity of channelizing devices required for the message boards are already included in the quantity for **Channelizing Device, 42 inch, Flourescent, Furn**.

8. Permanent Pavement Markings.

    a. Permanent pavement markings consist of the following:

    Pavt Mrkg, Waterborne, 6 inch, White
    Pavt Mrkg, Waterborne, 6 inch, Yellow
    Pavt Mrkg, 24in Crosswalk, Special
    Pavt Mrkg, Waterborne, For On-Street Parking, 4 inch, White
    Pavt Mrkg, Waterborne, 12 inch, Cross Hatching, White
    Pavt Mrkg, Waterborne, 12 inch, Cross Hatching, Yellow
    Pavt Mrkg, Waterborne, 24 inch, Stop Bar

Pavt Mrkg, Waterborne, 12 inch, Yellow, Curb Painting
Pavt Mrkg, Waterborne, 6 inch, Solid Turning Guide Line, White
Pavt Mrkg, Waterborne, 6 inch, Dotted Thru Guide Line, White
Pavt Mrkg, Waterborne, Lt Turn Arrow Sym
Pavt Mrkg, Waterborne, Only
Pavt Mrkg, Waterborne, Rt Turn Arrow Sym
Pavt Mrkg, Waterborne, Thru and Rt Turn Arrow Sym
Pavt Mrkg, Waterborne, Thru Arrrow Sym
Pavt Mrkg, Waterborne, Accessible Sym
Pavt Mrkg, Waterborne, Xing
Pavt Mrkg, Waterborne, Ped

b. Fabricate all pavement markings per MDOT Pavement Marking Standards and Special Details PAVE-900 through PAVE-985.

9. Permanent Signs.

a. Fabricate and place permanent signs according to the current editions of the Michigan Manual on Uniform Traffic Control Devices (MMUTCD), Standard Highway Signs manual and sign support typicals, published by the Michigan Department of Transportation.

b. Mount all permanent signs at a 7-foot bottom height.

c. Fabricate all new permanent signs with high intensity reflective sheeting.

d. Install all permanent signs as shown on the permanent signing plans or specifications prior to opening roadways to traffic.

e. Replace signs requiring relocation, due to Contractor convenience or damage, at locations determined by the Engineer at the Contractor's expense.

i. Measurement and Payment. Maintain traffic according to sections 812 and 922 of the 2020 Standard Specifications for Construction. Estimated quantities for maintaining traffic on this project are based on the suggested sequence of operations contained in the staging plans and described in this special provision. Payments for these devices are in accordance with the 2020 Standard Specifications for Construction unless otherwise specified.

PROGRESS CLAUSE

Wightman/PAD 12/01/2023

The Engineer anticipates that construction can begin no earlier than ***April 1, 2024***.

In no case shall any work be commenced prior to receipt of formal notice of award by the City.

The Contractor shall prepare and submit a complete, detailed, signed Progress Schedule to the Engineer.

Phase 1, Phase 2, and Phase 3 less plantings and watering and cultivating must be complete and the project shall be open to traffic (Paved HMA top course, permanent signs, pavement markings, and restoration complete) on or before: ***July 5, 2024***

Plantings must be complete by: ***November 1, 2024***

All Contract work shall be complete on or before: ***September 19, 2025***

Unless specific pay items are provided in the contract, any extra costs incurred by the Contractor due to cold-weather protection and winter grading will not be paid for separately but will be included in the payment of other pay items in the contract.

After award and prior to the start of work, the Contractor must attend a preconstruction meeting with the Engineer. The Engineer will determine the day, time and place for the preconstruction meeting. The meeting will be conducted after project award and may be rescheduled if there are delays in the award of the project.

The named subcontractor(s) for Designated and/or Specialty Items, as shown in the Proposal, should attend the preconstruction meeting if such items materially affect the work schedule.

Failure by the Contractor to meet interim completion, open to traffic, and/or final completion dates will result in the assessment of liquidated damages in accordance with subsection 108.10 of the 2020 MDOT Standard Specifications for Construction.