

**MUNICIPALITY OF ANCHORAGE
STANDARD SPECIFICATIONS**

**DIVISION 80
TRAFFIC SIGNALS AND ILLUMINATION**

**STANDARD CONSTRUCTION SPECIFICATIONS
FOR TRAFFIC SIGNALS AND ILLUMINATION
DIVISION 80
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**STANDARD CONSTRUCTION SPECIFICATIONS
TRAFFIC SIGNALS & ILLUMINATION
DIVISION 80**

SECTION 80.01 GENERAL

Article 1.1 Scope of Work

Work shall consist of furnishing and installing, modifying, removing or salvaging one or more traffic signal systems, flashing beacon systems, illumination systems, sign illumination systems, traffic count stations, electrical equipment on structures, falsework lighting, partial installations for future systems, or combinations thereof, all as required by the Drawings, and as specified. All necessary labor and equipment to provide fully functioning traffic signals, intersection lighting, or roadway illumination is included.

Prior to installation of foundations, junction boxes, and conduits; Contractor shall locate and protect all new and existing underground utilities; including, but not limited to, pipelines, signal systems, thaw wires, lighting systems, storm drain, sanitary sewers, water systems, and telephone, cable television, and electrical cables. Not all of the existing utilities may be present or shown on the Drawings. Contractor shall adjust foundation, junction box, or conduit location if conflict exists with either existing utilities or proposed improvements. No additional monies are paid or owed to Contractor for the adjustment.

Materials furnished shall be new, except such used materials as may be specifically provided for on the Drawings or in the Special Provisions. Where an existing system is to be modified, the existing material shall be reused on the project, or disposed of as shown in the Drawings, or specified in the Special Provisions.

All systems shall be complete and in operation with all materials in conformance with Drawings, Specifications and the manufacturer's specifications and recommendations, at the time of final acceptance.

Article 1.2 Regulations and Codes

All material, and workmanship where applicable, shall conform to the standards of the Underwriters Laboratories, Inc., the National Electrical Code, and the National Electrical Safety Code together with local amendments. Within this Division, the term "Code" shall mean the National Electrical Code, and the National Electrical Safety Code together with local amendments. For all Division 80 items, furnish listed or labeled components, including individual components as well as complete assemblies, with the listing or labeling.

Where applicable, all electrical equipment shall conform to the standards of the National Electrical Manufacturers Association.

The 1994 Edition of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" published by the American Association of State Highway and Transportation Officials (AASHTO) shall be referred to in this Division as the 1994 AASHTO design criteria. The 2001 Edition AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" shall be

referred to in this Division as the 2001 AASHTO design criteria. The 2013 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals with 2013 Errata and 2015 Interim Revision shall be referred to in this Division as the 2013 AASHTO design criteria with interim revisions.

Article 1.3 Equipment List(s) and Drawings

- A. The Contractor shall submit for review and approval, within thirty (30) days following award of the Contract, eight (8) collated copies of a portfolio of equipment and materials which he proposes to install. The portfolio(s) shall consist of a table of contents which includes each item's intended use(s) and the following:
1. For materials on the Approved Products List: a description that includes product name, manufacturer, model or part number, and the conditions listed for approval.
 2. For materials not on the Approved Products List: catalog cuts that include the manufacturer's name, type of product, size, model number, conformance specifications, and supplemented by other data as may be required, including manufacturer's maintenance and operations manuals, or sample articles.
 3. A wind stress certificate from the manufacturer of poles, signal mast arms, and luminaire arms. Contractor shall submit to the Engineer for approval the Wind Stress Certificate that includes the signed stamp of a professional engineer registered in the State of Alaska; and a statement that indicates that the poles and mast arms meet the wind and mast arm loading requirements specified in Section 80.05, Article 5.1 - General.
 4. Contractor shall submit to the Engineer for approval the Materials Certifications for all lighting poles, signal poles, mast arms, connector bolts and anchor bolts, indicating that the steel and galvanizing conform to the requirements in this Division.

The Municipality shall not be liable for any material purchased, labor performed, equipment used, or delay to the Work before all equipment and materials have been reviewed and approved.

- B. Three (3) paper copies and two (2) electronic copies, in Adobe pdf format and AutoCAD v2019 or later format of traffic controller cabinet schematic wiring diagrams shall be submitted at the time the controllers are delivered for testing, or if ordered by the Engineer, prior to purchase. This diagram shall list all equipment installed in each cabinet and show in detail all circuits, parts, and schematic wiring. Contractor shall also provide at this time, one (1) reproducible and one (1) electronic set in Adobe pdf format of Operation and Maintenance manuals and wiring diagrams of any cabinet equipment utilized. These manuals shall show in detail all circuits and parts. Such parts shown thereon shall be identified by name or number and in such a manner as to be readily interpreted.
- C. The Contractor shall prepare five (5) complete sets of red lined as-built plans which shall be kept current with the construction. These as-built plans shall detail all construction changes made to the Drawings and also include the following information on each appropriate drawing:

1. Location and depth of conduit runs.
2. Station and offset of all junction boxes.
3. Heights of signal faces and overhead signs.

Copies of such as-built plans shall be furnished at least twice a month during construction so that they may be reviewed for accuracy and completeness. The Contractor shall furnish any additional information required to clarify the as-built plans and shall correct all discrepancies. Progress payment for the signal and illumination Work completed shall not be made until accurate as-built plans reflecting the construction progress have been reviewed and deficiencies corrected.

- D. Prior to final inspection of the Work, Contractor shall submit five (5) complete sets of Record Drawings to the Engineer. The Engineer shall deliver one (1) copy each to Project Management & Engineering; Traffic Department, Signals Section; Traffic Signal Maintenance Shop; Maintenance & Operations, Street Light Maintenance Supervisor; and attach the appropriate sheets of the fifth set in clear envelopes to the inside of each load center.

Article 1.4 Warranties, Guarantees and Instruction Sheets

Manufacturers' warranties, guarantees, instruction sheets and parts furnished with materials used in the Work shall be delivered to the Engineer.

For equipment brands and models not currently in use within the Municipality of Anchorage, a manufacturer's representative shall be present to supervise the turn on and adjustment of the signal system. In addition, the representative shall provide one workday of continuous instruction and familiarization in the operation and maintenance of the signal system.

Article 1.5 Maintaining Existing and Temporary Electrical Systems

The Contractor shall maintain the traffic signal and lighting systems, from the time of the Notice to Proceed until the time of final acceptance except during any authorized stoppages when the Municipality of Anchorage shall assume maintenance. Temporary replacement equipment furnished by the Contractor shall be compatible with existing equipment used in the MOA. and approved by the Engineer. Representatives of the Contractor and the Owner shall inspect the project prior to the winter shutdown and prior to spring startup to ascertain those items that need repair and determine responsibility for the repairs. If the project includes traffic signal Work, Traffic Signal Maintenance personnel shall be included in the inspection.

The existing Traffic Signal installation may not be shut down between 7:00 and 8:30 a.m. or 3:00 and 6:00 p.m. weekdays.

The local traffic enforcement agencies and Traffic Department, Signals Section shall be notified prior to any operational shutdown of a traffic signal system.

The Contractor and the Traffic Signal Maintenance personnel shall do a walk-through inspection of the existing traffic signal system prior to commencing Work.

The Contractor shall provide temporary signalization. At no time shall a signalized intersection operate in an unsignalized mode, except for shutdown due to change over

from the existing system to a temporary system, and from the temporary system to a permanent system. Temporary signal system shutdowns shall be limited to periods during normal working hours as specified in this Section, during which flag control shall be used.

The temporary signal system plan shall be submitted to and approved by the Municipal Traffic Engineer or assigned designee prior to implementation. The temporary signal plan shall equal or exceed the system being replaced or modified. That is, the plan shall not downgrade the number of signal heads, signal phases, pedestrian push buttons, emergency preemption detectors, traffic signal communications, etc. The temporary signal system plan shall also include the layout of the temporary intersection. The complete plan shall include intersection geometrics, lane widths, and auxiliary lane pocket lengths.

No vehicle detection shall be required in a temporary system, unless called for in the Drawings and Specifications or specified by the Traffic Department.

The Contractor shall coordinate all Signal Work with the Traffic Signal Maintenance Shop at 343-8355.

The Contractor shall be responsible for maintaining any span wire temporary signal installed. The Traffic Department shall not assume maintenance responsibility for span wire systems.

The Contractor shall obtain Traffic Department approval prior to turning any maintenance responsibilities over to the Traffic Department, including any maintenance required during Winter Shutdown.

The Contractor shall furnish and install all materials and miscellaneous hardware required to provide a functional traffic signal system. All materials shall conform to the requirements of the Drawings and Specifications. Temporary equipment shall be compatible with existing equipment used in Anchorage.

The temporary signal system may consist of any combination of the following:

1. The existing systems,
2. Relocation of component parts,
3. Guyed wood poles, or
4. Any portion of the permanent signal system.

Traffic signals may be suspended from span wire system provided that they are mounted to a catenary cable by standard span wire hangers and secured with a tether wire to prevent misalignment in the wind. Signal cables shall be routed along a separate messenger cable. The span wire cable system shall meet all the requirements shown in the Temporary Traffic Signal Span Wire Details. Messenger cables shall be at least three-eighths inch (3/8") O.D. "High Tensile" grade cable. Tether wire shall be one-eighth inch (1/8") O.D. steel cable installed with a minimum ground clearance of nineteen feet (19'). Catenary cables shall be at least three-eighths inch (3/8") O.D. steel cable. All signal faces shall be equipped with backplates and visors and LED modules. The signal faces of each phase with two or more faces shall be energized using a minimum of two (2) circuits, with each circuit wired with IMSA 20-1 signal cable. Splices shall be made only at the terminal blocks in the signal faces. Sufficient signal cable

slack shall be left at each pole to provide for drip loops and to allow realignment of each signal head. All pedestrian signals shall be equipped to display a countdown timer when the flashing don't walk is on.

Whenever a pole of the existing or permanent signal system is included in a span wire signal system, the Contractor shall guy the pole and provide protective collars to prevent chafe damage. Poles with breakaway bases shall not be included in a span wire supported signal system.

The Contractor shall provide illumination at all locations with preexisting lighting and at all intersections where temporary traffic signalization is specified to be provided.

The temporary facilities shall be provided during the life of the Contract on all roadways open to traffic within project limits. The temporary lighting systems shall be operational by sunset on the same day the replaced system is retired, or the roadway is opened to traffic.

A plan for each temporary lighting system shall be submitted to and approved by the Engineer prior to implementation. The temporary lighting plan shall equal or exceed the system(s) being replaced or modified. At intersections, the temporary system shall include a luminaire located on the far right for each through street approach and installed adjacent to the through street radius returns. The through street is the street with the vehicular right of way; both streets shall be considered through at signalized intersections and four-way stops.

The Contractor shall furnish and install all materials and miscellaneous hardware required to provide a functional lighting system including electrical load centers. All materials shall conform to the requirements of the Drawings and Specifications, except that the branch conductors may be triplex aluminum with messenger cable if they are installed overhead. Illumination conductors shall be sized so that the voltage at the most remote luminaire is not less than specified by the luminaire manufacture for equipment operation. The Contractor shall install intermediate conductor and supports to energize luminaires at locations without electrical service.

Luminaires used in the system may be the existing fixtures or new fixtures with a light distribution compatible with the proposed lighting configuration.

The temporary lighting systems may consist of any of the following lighting pole types, or combinations thereof, provided the luminaires have a minimum of thirty feet (30') mounting height. Mounting height is the difference in elevation between the luminaire retractor and the edge of traveled way at the same station. The existing poles may be reused if they are not utility owned. Any pole of the permanent lighting and temporary signal systems and any Contractor-supplied poles may be wood and shall meet 1994 AASHTO design criteria for one hundred mile per hour (100 mph) winds with gusts to one hundred thirty miles per hour (130 mph). All poles, except traffic signal poles, installed within the clear zone shall be provided with FHWA approved slip bases, transformer bases, or frangible couplings.

The load centers to power the temporary lighting and signal systems may be the permanent installations, the existing installations, or temporary installations. The existing load centers may be used only if they are scheduled to remain intact until completion of the project, and reused only if they are approved. The Contractor shall

provide approved temporary load centers with photoelectrically-controlled lighting circuits whenever a load center is unavailable for use, or when an existing load center that is not approved is retired due to conflict with the Work. An approved load center is any load center UL labeled as Service Equipment, or UL labeled as Industrial Control Equipment and marked "suitable for use as service equipment." The Contractor shall provide all Work to modify these load centers as required to provide functional temporary lighting and signal systems, and to install them completing all Work in accordance with the NEC.

Once the Contractor commences Work on the project, they shall provide all maintenance for the existing electrical facilities. The Municipality shall pay for the electrical power for the abovementioned electrical systems. The above maintenance does not include any prior damage such as burned-out lamps, nonoperative detection or other malfunctioning equipment. The Contractor shall present written documentation of all nonfunctioning and malfunctioning electrical equipment before commencing Work on the project. This malfunctioning equipment shall be inspected jointly by personnel from the Engineer's staff and the Contractor. In the event the Engineer does not receive notice in writing and the Contractor begins Work on the project, this shall suffice as evidence that all equipment is functional and operational.

The Contractor shall furnish the Engineer with the name and phone number of the person responsible for maintaining existing and temporary electrical facilities. Repair work shall commence within one hour of notification for traffic signal systems.

The exact location of existing conduit runs, direct burial cable, pull boxes, and all underground utilities shall be ascertained by the Contractor before using equipment that may damage such facilities or interfere with any system.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, the lighting systems shall remain in operation and the final connection to the modified circuit shall be made so that the modified circuit will be in operation by nightfall of the same day the final connection is made.

Temporary electrical installations shall be kept in effective operation until no longer required. Removal of temporary installations shall conform to the provisions in Section 80.28 – Salvaging Electrical Equipment.

These provisions shall not relieve the Contractor in any manner of his responsibilities as provided in Division 10, Section 10.06 - Legal Relations and Responsibilities.

Article 1.6 Scheduling of Work

Work shall be so scheduled that each new traffic signal system, lighting system, and sign illumination system shall be completed and ready for operation prior to opening to traffic of the corresponding section of new alignment.

Traffic signal systems shall not be placed in operation without energizing the street lighting at the intersection to be controlled if street lighting exists or is being installed with the traffic signals.

Contractor shall not place traffic signal systems into operation. Traffic Signal Maintenance personnel are the only persons authorized to turn on a traffic signal.

Conductors shall not be pulled into conduit until pull boxes are set to grade, crushed rock sumps installed, grout placed around the conduit, and metallic conduit bonded.

In vehicular undercrossings, soffit lights shall be placed in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures shall be placed in operation prior to opening the structure to pedestrian traffic.

If the Engineer orders soffit lights or lighting for pedestrian structures placed in operation before permanent power service is available, the cost of installing and removing temporary power service shall be paid for as extra Work as provided in Division 10, Sections 10.05 – Control of Work and 10.07 – Measurement and Payment.

Article 1.7 Safety Precautions

Before starting Work on existing series street lighting circuits, the Contractor shall obtain daily, a safety circuit clearance from the serving utility. By-pass switch plugs must be pulled and suitable signs posted at switch boxes before electrical Work begins.

Suitable signs shall be posted at Load Centers when a contractor is working on any of the circuits from that Load Center.

Article 1.8 Definitions

The Definitions in NEMA TS-2, Traffic Controller Assemblies with NTCIP Requirements Version 02.06, shall be used along with the following:

1. Electrolier: The complete assembly of pole, luminaire arm, luminaire, ballast, and lamp.
2. Luminaire: The assembly which houses the light source and controls the light emitted from the light source. Luminaires consist of the optical, electrical, and mechanical/thermal components of the assembly.
3. Lighting Standard: The pole and luminaire arm which must support the luminaire.
4. Vehicle: Any motor vehicle licensed for highway use by the State of Alaska.
5. Controller Unit: The solid-state device as described in Section 80.17, Article 17.2 – Controller Unit.
6. Controller Cabinet: A cabinet constructed, wired and equipped as described in Section 80.17, Article 17.5 - Controller Cabinet.
7. Controller Assembly. The controller cabinet, controller unit and the equipment described in Section 80.17. The controller assembly shall also be functioning in accordance with Section 80.17, Articles 17.1-General and 17.6 - Operation.
8. Anchor bolts apply to Luminaire poles and anchor rods apply to Signal poles. They are used interchangeably in this Division.

Article 1.9 Signs

Reference Division 85, Section 85.04 – Standard Signs.

Article 1.10 Measurement

All Work in this Section shall be measured by lump sum and shall consist of all labor, materials, and equipment necessary to provide temporary signalization and temporary illumination.

Article 1.11 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Temporary Signalization	Lump Sum
Temporary Illumination	Lump Sum

SECTION 80.02 EXCAVATING AND BACKFILLING

Article 2.1 General

The excavations required for the installation of conductors, conduits, foundations and other appurtenances shall be performed in such a manner as to avoid any unnecessary damage to the streets, sidewalks, landscaping, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appurtenances and foundations. Excavation shall not be performed until immediately before installation of conduit and other appurtenances. The material from the excavation shall be placed in a position that will not cause damage or obstruction to vehicular and pedestrian traffic nor interfere with surface drainage.

Trench, backfill, and disposal of surplus material shall be performed in accordance with Division 20 – Earthwork.

Excavations after backfilling shall be kept well-filled and maintained in a smooth and well-drained condition until permanent repairs are made.

All excavations shall be filled, and sidewalks, pavement, and landscaping restored at each intersection prior to excavating at any other intersection. Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted in either direction at any time, unless otherwise provided in the Special Provisions.

Article 2.2 Construction

The Contractor shall excavate the trench to the proper depth as described herein and as shown on the Drawings.

The excavations shall be backfilled with material suitable to the Engineer. All backfill placed in the roadway area shall be Type II-A classified backfill as specified in Division 20, Section 20.21, Article 21.2 - Material. All backfill material shall be placed in uniform layers of not more than six inches (6") in depth and compacted to a density of not less than ninety-five percent (95%) of the maximum density as directed by the Engineer.

The Contractor shall be responsible for the restoration of all surfacing, turf, and native material to the original condition and appearance.

Article 2.3 Sawcut Trench

Where shown on the Drawings, or as directed by the Engineer, the Contractor shall construct a sawcut trench as detailed in the Drawings. A sawcut trench shall be used to cross existing traveled lanes, existing curb and gutter, in median islands, along edges of paved roadways, and in sidewalk areas where a neat cut of the surfacing is required.

The Contractor shall cut the surfacing material full depth and remove the surfacing material to expose the subgrade materials. The Contractor shall then excavate a trench, dispose of excess and waste materials, and install conduit as described herein.

In sawcuts of asphalt pavement located within the roadway pavement, Contractor shall remove a minimum distance of one foot (1') back from the edge of the trench, on each side of the trench. Contractor shall remove pavement such that cuts parallel to the direction of travel are not located within the wheel paths.

The entire trench shall be backfilled as specified herein, except non-frost-susceptible sand bedding material shall be used.

The existing surface shall then be restored with like pavement in accordance with Section 40.07 - Remove and Replace Existing Asphalt Surfacing; Section 40.06 - Tack Coat; Section 30.03 - Portland Cement Concrete Sidewalks; or Section 30.02 Portland Cement Concrete Curb and Gutter, and Valley Gutter, as applicable.

Where applicable, asphalt tack coat shall be applied to all edges of the existing pavement prior to placing new asphalt. Asphalt pavement less than three inches (3") in thickness shall be placed in one lift, and asphalt pavement three inches (3") and greater in thickness shall be placed in a minimum of two equal lifts.

In median islands, the Contractor may elect to remove and replace the entire surface of the island along the length of the conduit run. If the Contractor elects to remove the entire surface of the island, the Work shall still be considered as sawcut trenching. The layer of pavement under the median islands, if encountered (normally at the street pavement grade), may be broken out.

The Contractor shall be responsible for the restoration of all surfacing, turf, and native material to original condition and appearance.

Article 2.4 Measurement

Measurement for trench and backfill and for sawcut trench shall be per linear foot of horizontal distance of the various widths and depths as set forth in the Bid Schedule. Measurement shall be from station to station or from center of device to center of device as staked in the field and as shown on the Drawings.

Article 2.5 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Work not specifically identified for payment under a separate pay item, but required for normal completion of trench and backfill, will be considered incidental and shall be included in the linear foot cost of the trench. Sawcut trench includes removing existing pavement, trench and backfill, and replacing pavement.

Payment shall be made under the following units:

ITEM	UNIT
Trench and Backfill (Width) (Depth)	Linear Foot
Sawcut Trench (Width) (Depth)	Linear Foot

SECTION 80.03 REMOVING AND REPLACING IMPROVEMENTS

Article 3.1 General

Improvements such as sidewalks, curbs, gutters, Portland cement concrete and asphalt concrete pavement, base material, lawns and plants and other improvements removed, broken or damaged by the Contractor's operations, shall be replaced or reconstructed with the same kind of material as found on the Work or with materials of equal or better quality. The new Work shall be left in a satisfactory serviceable condition.

Whenever a part of a square or slab of existing sidewalk, curb and gutter, or driveway is broken or damaged, the entire square, section or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in concrete sidewalks and driveways and in pavements shall be cut to a minimum depth of one and one-half inches (1 1/2") with an abrasive type saw prior to removing the sidewalk, driveways, and pavement material. The cut for the remainder of the required depth may be made by a method satisfactory to the Engineer. Cuts shall be neat and true with no shatter outside the removal area.

When a foundation is to be abandoned in place, the top of foundation, anchor bolts, and conduit shall be removed to a depth of not less than one foot (1') below surface of sidewalk or unimproved ground. The resulting hole shall be backfilled with material equivalent to and compacted to the density of the surrounding material.

Article 3.2 Measurement

All Work under this section is incidental to other Work and shall not be measured or paid for directly.

Article 3.3 Basis of Payment

No separate payment shall be made for this item.

SECTION 80.04 FOUNDATIONS

Article 4.1 General

All foundations for poles, posts and pedestals shall be cast-in-place Portland Cement Concrete. Luminaire poles may be constructed on driven pile foundations.

Unless otherwise shown on the Drawings, all items to be relocated shall be provided with new foundations and anchor bolts of the proper type and size.

The Contractor shall be responsible for contour grading around all post, pole, and pedestal foundations. Final or finished grading shall be such that the earth shall be two inches (2") below the top of the base and drain away from the base.

Foundations for signal poles and breakaway 10' signal poles shall be designed in conformance with the requirements of the 2013 AASHTO design criteria.

Foundations for luminaire poles shall be designed for one hundred mile per hour (100 mph) winds with gust to one hundred thirty mile per hour (130 mph), in conformance with the requirements of the 1994 AASHTO design criteria.

Cabinet foundations shall be precast.

The entire controller foundation, and the entire pole foundation shall be formed and the top given a smooth steel trowel finish. Conduits shall be located in the center of the pole-post foundations with clearance allowed for bushings.

The top of any foundation located on a slope shall be constructed such that the finished slope passes through the top center of the uphill edge of the foundation. The area two feet (2') up and down slope of the edge of the foundation shall be graded so that no portion of the foundation projects above the surrounding slope and so that water will drain away from the foundation.

The Contractor shall field-verify pole foundation stationing and elevations prior to pouring the foundations, to ensure that the final locations of the signal heads and mast arms meet the requirements of the Drawings and Specifications. The field-verification includes checking to ensure that the heads shall be the proper distance above the roadway surface, and mast arms shall be of adequate length to place heads and signs in the right locations. Any discrepancies shall be reported to the Municipal Traffic Engineer prior to pouring the foundation.

Article 4.2 Cast-In-Place Concrete Foundations

The Contractor shall use a minimum 14 gauge corrugated steel pipe (CSP) form to cast concrete foundations in place. The Contractor shall over excavate the area around the form enough to allow for proper compaction. The backfill operation shall conform to the requirements of Division 20, Section 20.19 – Furnish Foundation Backfill. Contractor shall obtain approval from the Municipal Traffic Engineer prior to use of any material that is not specifically identified in Furnish Foundation Backfill. Substitution requests for alternate material, including any flowable fill, shall be designed to produce a comparable compressive strength to the surrounding soil after hardening. The use of water for drilling operations or for any other purpose where it may enter the hole is not permitted.

Concrete shall be Class AA-3 Portland Cement conforming to Division 30 – Portland Cement Concrete.

Reinforcing steel and wire fabric shall conform to the requirements of Division 30, Section 30.01, Article 1.3 – Materials and Section 80.05 – Poles, Steel Pedestals and Posts. Reinforcement shall be placed and fastened in conformance with Division 30, Section 30.05, Article 5.2 – Construction, except that bars to be spliced shall be lapped at least fifty (50) bar diameters. Where bar spacing is less than one (1) foot in each direction, the Contractor may tie alternate intersections.

Drilled holes or forms shall be vertical, and true to the locations shown in the Drawings. Upon completion of excavation for a foundation, and prior to the placement of concrete, all loose material shall be removed in order that the foundation rests on firm, undisturbed ground.

Forms, if indicated or required, shall be true to line and grade, with the top of the foundation at the established elevation.

Conduit shall be included in all concrete foundations for wire and cable entry as shown on the Drawings as required to complete the Work. The conduit in pole or post foundations shall extend above the foundation as shown on the Details (but not above the slip base adapter). These conduits shall exit the foundations in the top center of the foundation surface.

The reinforcing steel cage, if required, shall be placed and secured symmetrically about the vertical axis and shall be securely blocked to clear the sides of the foundation. Anchor bolt assemblies and conduit ends and reinforcing bar assemblies shall be securely supported by templates. Each anchor bolt shall have two (2) nuts and two (2) plate washers.

Anchor bolts, nuts and washers shall conform to ASTM F1554 and shall be hot-dip galvanized after fabrication in accordance with ASTM A153. Anchor bolts for signal mast arm foundations shall conform to ASTM F1554 and Section 80.05, Article 5.4 – Signal Pole Anchor Rods and Bolts. The grade of steel shall be as specified by the pole manufacturer, for the loading specified in Section 80.05, Article 5.1 – General. The exposed end of all anchor bolts used for signal mast arm poles shall be clearly stamped with the appropriate markings so that the type of bolts used in the foundation can be clearly determined after construction, per ASTM F1554 supplementary requirements S2, S3, and S5. Signal mast arm foundation anchor bolts shall conform to Charpy Impact Requirements at –20°F, per supplementary requirement S5. Anchor bolts may not be field cut or bent. Damage to galvanized surfaces as a result of damage during shipping or construction activities shall be repaired in accordance with Section 80.16, Article 16.3 – Galvanizing.

Furnish each anchor bolt with two nuts and two washers. Install the bottoms of the bottom leveling nuts in a level plane within one inch (1”) of the top of foundations. Adjust nuts until their tops form a level plane. Install one washer on top of leveling nuts and, after setting the pole on these washers, install one washer under top nuts. Bring leveling nuts (bottom nuts) to full bearing on the bottom of the base plate. Generously lubricate the bearing surface and internal threads of top nuts with beeswax. Tighten top nuts to a “snug” condition. Use a click type torque wrench to apply 600 foot-pounds of torque to the “snug” top nuts. After the top nuts are tightened to the correct torque, use a hydraulic wrench to rotate top nuts an additional one sixth (60 degree) turn, while preventing the leveling nuts from turning.”

Material certifications for all anchor bolts shall be submitted to the Municipal Traffic Engineer or designated representative prior to acceptance of the foundations for payment.

Reinforcing bars shall be formed into cages and all intersections tied with #14 AWG steel wire. The cages shall be accurately held in position during placing and setting of the concrete. All reinforcing bars shall be bent cold in as smooth a curve as possible and shall conform to standard practice of the WCRSI. Reinforcing steel shall not be welded except as shown in the construction detail Drawings.

All reinforcing steel shall have a minimum of one inch (1") of concrete cover for controller cabinet and load center foundations. Cover for signal pole and luminaire foundations shall be as identified in the appropriate Standard Detail.

Surface water shall not be permitted to enter the hole and all water which may have infiltrated in the hole shall be removed before placing concrete. Both forms and ground shall be thoroughly moistened before placing concrete. Each foundation shall be poured in one continuous pour.

Posts, poles and pedestals shall not be erected or placed on the foundation until ten (10) days after placement of the concrete. If the Engineer approves Type III Portland High-Early-Strength Cement Concrete, then posts, poles and pedestals may be placed on foundations four (4) days after placement of the concrete. Plumbing shall be accomplished by adjusting the nuts on the anchor bolts. Shims or other similar devices for plumbing or raking are only permitted for breakaway pole installations.

After each slip-base post, pole or pedestal is in position, grout conforming to Section 80.05, Article 5.3 – Grouting for Slip-Base Poles, shall be placed under the base plate as shown on the Detail Drawings, and shaped to present a neat appearance. Contractor shall install metal skirting on all non-slip-base posts, poles, or pedestals.

Attach a #4 AWG, bare, copper wire as a grounding electrode conductor to the #4 spiral bar in the reinforcing steel cage. Use two irreversible compression connectors to make the attachment. Protect the attachment during concrete placement. In foundations that lack reinforcing steel cages, install 21 feet of coiled #4 AWG, bare, copper wire as the grounding electrode. Route the conductor to protrude near the top, center of the foundations. Slide a minimum six inch (6") long, PVC or HDPE, protective sleeve over the conductor. Allow one inch (1") of the sleeve and twenty-four inches (24") of conductor to protrude from the foundations.

Install anchor bolts and rods plumb. Anchor bolts and rods greater than 1:40 out of plumb will result in rejection of foundation. Contractor shall reconstruct rejected foundations at no additional expense to Owner.

MATERIAL REQUIREMENTS		
Concrete	Class AA-3	F'c = 4000 psi
CMP	AASHTO M218	14 ga
Vertical Reinforcing Steel	AASHTO M31 #11	GR 60
Spiral Reinforcing Steel	AASHTO M31 #5	GR 60
Ground Wire		#4 AWG
Anchor Rods 2"x96"	ASTM F1554 S2, S3, & S5	GR 105
Fasteners, Washers	AASHTO M293	
Fasteners, Nuts	AASHTO M292	
Finish, Anchor Rods & Fasteners	AASHTO M232	
Ring Plate	AASHTO M270	GR 36
Conduit	Sch 40	RMC
Protective Sleeve	Sch 40	PVC

Article 4.3 Load Center Foundation

Excavate sixty inches (60") for base and install eighteen inches (18") of coarse aggregate for drain. Backfill above gravel in six inch (6") lifts with non-frost-susceptible material, compacting to ninety-five percent (95%) in accordance with Division 20 – Earthwork.

Install base so that cast-iron cover is flush with pavement, sidewalk, or finished grade. Slope grade away from base with minimum slope of three percent (3%). Use a pre-molded bituminous joint between base and concrete sidewalk or paving.

Install a three-quarter inch by ten foot (3/4"x10') copper clad ground rod inside the base, readily accessible through the removable steel cover. Install an additional external three-quarter inch by ten foot (3/4"x10') copper clad ground rod eight feet (8') from the load center, and additional ground rods as required by Code or the electrical utility.

Connect cast-iron cover of load center base to the ground rod with six feet (6') of copper braid with eyelets every six inches (6") and approved connectors.

Access opening shall be finished with a twenty-four inch (24") square iron frame and cover, approximately 280 pounds total weight, as provided by Olympic Foundry, Part No. SM70 or approved equivalent.

Install four (4) each, three-quarter inch (3/4") ferrule loop inserts for lifting, two (2) on each long side.

Provide one inch (1") chamfer on all exposed concrete edges.

For two-piece units, seal joint with pre-molded plastic bituminous type joint sealer.

Article 4.4 Controller Cabinet Foundation

Contractor shall install controller cabinet foundation in conformance with Standard Details 80-5, 80-6, 80-7, and 80-8. The top surface of controller cabinet foundations

shall be eighteen inches (18") above finished grade and provided with a one inch (1") diameter drain hole connected to the cabinet interior and emptying above the ground line. All conduits shall be placed in the front half (door side) of the foundation to provide adequate wiring terminal block clearances.

Controller cabinet anchor bolts shall be as recommended by cabinet manufacturer and set with a template. Install a three-quarter inch by ten foot (3/4"x10') copper clad ground rod inside the base, readily accessible through the removable steel cover.

Controller cabinet foundations shall be installed in accordance with Section 80.04, Article 4.3, SubArticles 1, 2, 6, 7 and 8.

Article 4.5 Driven Pile Foundation

Driven pile foundations shall not be used for signal poles.

Contractor shall supply driven pile foundations of the size and length indicated. Contractor shall ensure that the top surface of the anchor plate is three inches (3") above finished grade at luminaire pole locations or as indicated in the Drawings.

After welding on the pile cap adapter and anchor plate to the driven steel pile, Contractor shall cold galvanize the pile cap, the pile cap adapter, anchor plate, and the top three feet (3') of the steel pile including pile cap and anchor plate. Contractor shall furnish galvanization that complies with Federal Specification DOD-P-210354A (Galvanizing Repair Spec) and is U.L. listed. Contractor shall prepare steel surfaces and apply the cold galvanizing compound in accordance with the manufacturers' recommendations. Five days prior to applying the cold galvanizing compound, Contractor shall provide the Engineer a copy of the manufacturers' instructions.

Driven pile foundation for breakaway traffic signal pole shall be as shown on the Plans and M.A.S.S. Standard Detail 80-12 for the base plate.

Contractor shall excavate a hole with a vactor truck before installing piles when proposed pole location is within 10-feet of an existing buried utility. Excavation depth shall be a minimum of 12-inches below the anticipated depth of the utility before installing pile. Excavation shall be backfilled and compacted after pile installation is complete.

Article 4.6 Measurement

Foundations shall be measured as units, complete and in place. All survey and staking work required to locate the foundations shall be incidental to the work and no separate payment shall be made. All work to excavate and backfill a hole with a vactor truck for pile foundations shall be incidental to the work and no separate payment shall be made.

Article 4.7 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Cast-In-Place- Luminaire Pole Foundations	Each
Driven Pile Luminaire Pole Foundations	Each
Controller Cabinet Foundation (Type)	Each
Signal Mast Arm Pole Foundation	Each
Signal Breakaway Pole Foundation	Each
Driven Pile Signal Breakaway Pole Foundation	Each
Pedestrian Pushbutton Pole Foundation	Each
Load Center Foundation (Type)	Each

SECTION 80.05 MAST ARMS, POLES, STEEL PEDESTALS AND POSTS

Article 5.1 General

A registered professional engineer shall design the structures and provide stamped shop drawings and calculations. Submit the stamped drawings and calculations for each pole to the Municipal Traffic Engineer for approval. Design for the complete-in-place structure including the supported hardware.

In the stamped calculations, indicate the edition of Standard Specifications to which the poles are being designed and provide the input data used to design each pole and mast arm, including: design wind speed, cross section shape, yield strengths of the component materials, dimensions of the pole components, and a summary of the loads used.

On the stamped shop drawings, provide design wind speed and the details for building the luminaire poles, signal poles and mast arms, including: materials specifications, slip fit joint dimensions, pole component dimensions, welds that will be made, and the welding inspection that shall be done.

Contractor shall submit the mill certifications for the steel items (piles, plates, bolts, and other related items) to the Municipal Traffic Engineer or designated representative for written approval. Written approval is necessary for acceptance of and payment for the items identified in this Section.

All steel and iron products which are incorporated into poles, including connection and anchor bolts, shall be manufactured in the United States. All manufacturing processes starting with initial mixing and melting through the final shaping, welding and coating processes must be undertaken in the United States. Manufacturing includes smelting, rolling, extruding, machining, bending, grinding, drilling, painting and galvanizing. This does not apply to raw materials such as iron ore, pig iron, and processed, pelletized and reduced iron ore.

Non-Destructive Testing (NDT) may be required by the Municipal Traffic Engineer on all newly manufactured poles for this project, prior to galvanization. A licensed technician shall perform all testing. NDT shall take the form of Magnetic Particle or Ultrasonic testing, and be performed as described in the current AASHTO standard. If required all NDT reports shall be submitted prior to acceptance for payment.

No exception to the practices mandated by AASHTO shall be allowed.

Poles shall not be relocated or re-used unless Contractor obtains written approval of the Municipal Traffic Engineer or designated representative.

The Contractor shall verify the shaft lengths and mast arm connector plate locations of all poles to ensure the Drawing mounting heights of luminaires and traffic heads are met.

Damage to the galvanized or painted surface of existing poles to be relocated or reused in place and damage to the galvanized or painted surface that occurs during shipping or during the construction process, shall be repaired in accordance with Section 80.16, Article 16.3 – Galvanizing or Article 16.4 – Painting for Steel Structures, as appropriate prior to final acceptance of the poles and mast arms. Holes greater than five-eighths

inches (5/8") in diameter in the shafts of existing poles, due to removal of equipment, shall be repaired. Holes shall be repaired by tapping the hole, coating all exposed edges with zinc rich paint, and plugging the hole with a screw-in type steel plug of the correct size. The plug shall be galvanized, or shall be completely covered with zinc rich paint. Holes less than five-eighths inch (5/8") diameter shall be ground smooth so there are no notches or cracks, and coated with zinc rich paint. Plugging holes and repainting damaged galvanized or painted surfaces shall be incidental to the Project and no additional payment shall be made.

Article 5.2 Poles and Arms

A. Traffic Signal Breakaway Poles

Design and fabricate traffic signal structures to the 2001 Edition of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals with interim revisions and 10' Breakaway Traffic Signal Pole Details. Design must meet Fatigue Category II.

Fabricate signal structures from tapered steel tubes with a round or sixteen (16) sided cross section.

Fabricate tubes with walls up to half inch (1/2") thick from the prequalified base metals listed in AWS D1.1. Fabricate elements greater than half inch (1/2") thick from steel that conforms to AASHTO M270 and meets the Fracture Critical Impact Test requirements for Zone 3. Municipal Traffic Engineering will not accept structures that use laminated steel elements.

Fabricate the cross section of each tube from no more than one (1) piece of steel. Place the welded seams on adjacent sections to form continuous straight seams from the base to the top of the pole.

Fabricate breakaway signal poles in accordance with the 10' Breakaway Traffic Signal Pole Details. Fabricate signal poles from 7 gage (US Standard) sheet steel. Fabricate each post with a minimum inside diameter at the base plate as shown in the Drawings. Use four inch (4") diameter by four inch (4") Schedule 40, ASTM A53, Grade B pipe as a post-top adapter.

The Municipal Traffic Engineer does not allow holes made for lifting purposes in the ends of tubular segments. To add lift points, weld them to the tube opposite the longitudinal seam weld on the outside of female segments and on the inside of male segments. Before shipment, remove lift points added to the outside of the tubes, grind the area smooth with the base metal, and hot stick repair the finish in areas more than twelve inches (12") away from welds and slip fit areas, by applying minimum 7.8 mils of zinc based alloy applied according to ASTM A780. In areas that are within twelve inches (12") of welds and slip fit areas, make the repair by applying a minimum 7.8 mils of zinc rich paint applied according to ASTM A780.

Lift points added to the inside of tubes may be left in place.

The Municipal Traffic Engineer will reject poles and mast arms that are:

1. Not fabricated according to these specifications or the details,
2. Bowed with sweeps exceeding 1 inch throughout the length of the pole.
3. Out of round. Sections are out of round when the diameters of round members or the dimension across the flats of multisided members exceed 2 percent of the dimension specified on the shop drawings.

See Drawings for additional manufacturing and construction requirements.

B. Calculations: Signal Pedestrian Pushbutton Poles and Luminaire Poles and Arms

Street lighting poles, including luminaire arms and head mounting brackets, shall be designed and fabricated to the 1994 AASHTO design criteria.

Minimum design wind velocity shall be the greater of one-hundred miles per hour (100 mph) or the AASHTO recommendation based upon a fifty (50) year mean recurrence interval dependent upon project location. A factor of 1.3 shall be used in design calculations to account for wind gusts. The design for luminaire poles shall include a traffic sign with an area of sixteen (16) square feet, located with its centroid nine feet (9') above the base of the pole.

Should project plan loading develop shear or moments greater than those related to the above loading, special design poles are required. Those "Special Design" poles shall require calculation submitted to the Engineer for approval prior to use on the project.

Direct-embedded luminaire poles are not allowed.

C. Signal Pedestrian Pushbutton Poles and Luminaire Poles and Arms

Poles, prior to installation, shall be straight, with a permissive variation in sweep not to exceed one-quarter inch (1/4") per ten feet (10') of pole length.

A backing plate consisting of a metal sleeve shall be provided at all butt welded, transverse joints. The sleeve shall be No. 12 U.S. standard gauge steel minimum, and made from steel having the same chemical composition as the steel in the pole.

The metal sleeve shall have a minimum length of three inches (3"). The sleeve shall be centered at the joint and have the same taper as the pole outside the sleeve in full contact with the inside of the standard throughout the sleeve length and circumference. The weld metal at the transverse joint shall extend to the sleeve, making the sleeve an integral part of the joint. In round poles, standard steel pipe or tubing may be substituted for the tapered backing sleeve, at the discretion of the Engineer.

All welds shall be continuous. All welding practices shall conform to current AWS Code, AWS D1.1, latest edition.

All exposed welds, except fillet welds shall be ground flush with the base metal.

1. Poles

Pedestrian pushbutton posts shall be constructed of four inch (4") standard (Schedule 40) pipe and meet the requirements of ASTM A53. Multi-sided

poles shall not be used without prior approval of the Municipal Traffic Engineer.

Luminaire poles fifteen feet (15') or longer shall be round or multisided and fabricated from sheet steel of weldable grade.

Poles may be fabricated of full length sheets or shorter sections. When two pieces are used, the longitudinal welded seams shall be directly opposite one another. When the sections are butt-welded together, the welded seams on adjacent sections shall be placed to form continuous straight seams from base to top of pole.

All exposed edges of the plates which make up the pole base assembly shall be finished smooth, and all exposed corners of such plates shall be neatly rounded to one and one-half inch (1 1/2") radius, unless otherwise shown on the Drawings. Anchor holes in the base plate shall be round. Slotted holes shall not be used. Slotted shafts shall be provided with slip fitter shaft caps of either galvanized steel or cast aluminum.

2. Arms

Arms less than fifteen feet (15') in length shall be round or multisided, and constructed of No. 11 or heavier U.S. standard gauge steel, or four inch (4") standard (Schedule 40) pipe or conduit. Standard pipe shall conform to the specifications of ASTM A53.

Luminaire arms fifteen feet (15') or longer shall be round or multisided and fabricated from sheet steel of weldable grade.

Arms may be fabricated of full-length sheets or shorter sections. Each section shall be fabricated from not more than two (2) pieces of sheet steel for lengths up to forty feet (40'). Where two (2) pieces are used, the longitudinal welded seams shall be directly opposite one another. When the sections are butt-welded together, the welded seams on adjacent sections shall be placed to form continuous straight seams from base end of arm.

All exposed edges of the plates which make up the base of the arm shall be finished smooth and all exposed corners of such plates shall be neatly rounded to one-eighth inch (1/8") radius, unless otherwise shown on the Drawings. Bolt holes in the mast arm base plate shall be round. Slotted holes shall not be allowed. Mast arm ends shall be provided with slip-fitter shaft caps of either galvanized steel or cast aluminum.

D. Traffic Signal Poles and Arms Between 15' and 65'

Traffic signal structures shall be designed and fabricated to the 2013 AASHTO design criteria with interim revisions and the Standard Details. Design structures for a 50-year design life, Fatigue Category I with ice loading, and with a basic wind speed of 100 mph. Fatigue design shall include natural wind gust and truck-induced gust.

Fabricate signal and lighting structures from tapered steel tubes with a round or 16 sided cross section. Orient handholes located near the base of poles to face downstream of traffic flow.

Provide traffic signal poles, lighting poles, and signal mast arms in lengths evenly divisible by 5 feet.

Furnish mast arms up to 35 feet long in one piece. Mast arms 40 feet or longer shall be furnished in two segments with a slip type field splice per the Details. For slip type joints, provide a minimum overlap of two and one half (2.5) feet or the overlap specified in the Details, whichever is greater.

Fabricate tubes with walls up to 1/2 inch thick from the prequalified base metals listed in AWS D1.1. Fabricate elements greater than 1/2 inch thick from steel that conforms to AASHTO M270 and meets the Fracture Critical Impact Test requirements for Zone 3. The Municipal Traffic Engineer will not accept structures that use laminated steel elements.

Fabricate the cross section of each tube from no more than 2 pieces of steel. When using 2 pieces, place the longitudinal welded seams directly opposite one another. Place the welded seams on adjacent sections to form continuous straight seams from the base to the top of the pole.

When tenons are needed to install traffic signals and luminaires, make them from two inch nominal schedule 40 pipe that conform to ASTM A 53 Grade B.

The Municipal Traffic Engineer does not allow holes made for lifting purposes in the ends of tubular segments, except in the free ends of luminaire mast arms. To add lift points, weld them to the tube opposite the longitudinal seam weld on the outside of female segments and on the inside of male segments. Before shipment, remove lift points added to the outside of the tubes, grind the area smooth with the base metal, and hot stick repair the finish in accordance with Section 80.16, Article 16.3 – Galvanizing or Article 16.4 – Painting for Steel Structures, as appropriate. Lift points added to the inside of tubes in place may be left in place.

The Municipal Traffic Engineer will reject poles and mast arms that are:

1. Not fabricated according to these specifications or the approved shop drawings,
2. Bowed with sweeps exceeding 3/4 inch throughout the length of the pole, mast arm, or segment, if furnishing a 2 piece pole or mast arm,
3. Out of round. Sections are out of round when the diameters of round members or the dimension across the flats of multisided members exceed two percent (2%) of the dimension specified on the shop drawings.

MATERIAL REQUIREMENTS			
	Between 15' & 35'	Between 40' & 50'	Between 55' & 65'
ALL ASSEMBLIES			
Steel Through ½" Thick	ASTM A572 or A596		
Steel Over ½" Thick	AASHTO M270 F3 (50 ksi)		
Finish	AASHTO M111 & M232		
Mastarm Bolts	AASHTO M164		
Anchor Rods	Article 5.4 – Signal Pole Anchor Rods & Bolts		
POLE (LOWER SECTION)			
Design Length	21.5'		
Section Shape	Round		
Simplex Height	20'		
Fixed End Diameter	15.0" O.D.	17.0" O.D.	19.0" O.D.
Taper	0.14"/ft		
Tube Thickness	0.375"		
Base Plate	24"x24"x2.25"		
Bolt Circle	24"		
Signal Arm Plate	20"x20"x2.2 5"	22"x22"x2.25"	24"x24"x2. 25"
Top Ring Thickness	0.375"		
Bottom Ring Thickness	0.375"		
Gusset Plate Thickness	0.375"		
Handhole Cover Thickness	10 ga		
Pole Skirt Thickness	10 ga		
MASTARM			
Design Length	35'	50'	65'
Section Shape	Round		
Taper	0.14"/ft		
Tube Thickness	See Std Dtl 80-26A	See Std Dtl 80-26B	See Std Dtl 80-26C
Mastarm Rise	3.0 Degrees		
Base Plate	20"x20"x2.2 5"	22"x22"x2. 25"	24"x24"x2.25"
Bolt Circle	20"	22"	6 Vertical O.C.
Mastarm Bolts	1.5" x 4.5"		

POLE (UPPER SECTION)			
Fixed End Diameter	11.99" O.D.	13.99" O.D.	15.99" O.D.
Tube Material	A572, A595 GR A or A1011 50 ksi min		
Luminaire Tube	7 ga		
Connecting Plates	AASHTO M270 F3		
Concentric Reducer	A572 or A595 GR A		
Connection Tube	A572 or A595 GR A		
Upper Section Attachment Bolts	1"-8UNC / AASHTO M164		
Luminaire Attachment Bolts	0.75"-10 / AASHTO M164		
Slip-fit Through Bolt	0.625" / AASHTO M164		
Finish	AASHTO M111 & M232		
Handhole	7"x12.89" O.D.		
Section Shape	Round		
Taper	0.14" / ft		

E. Poles and Arms Greater than 65'

Refer to the project-specific Special Provisions and Drawings.

Article 5.3 Welding

Perform welding to conform to the 2001 Edition of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals with interim revisions; current American Welding Society code; the latest edition of AWS D1.1 – Structural Welding Code - Steel; the Standard Details; and the following:

1. Make welds continuous. Grind exposed welds flush with the base metal at slip fit joints for the length of the slip fit joint plus one half the diameter of the female section.
2. On steels 5/16 of an inch thick and thicker, inspect 100 Percent of CJP welds by either radiography (RT) or ultrasound (UT).
3. Inspect a random 25 percent of PJP and fillet welds by magnetic particle (MT). If a defect is found, inspect 100% of the PJP and fillet welds made to fill the order. In steels less than 1/8 inch thick, complete the tests according to AWS D1.1.
4. Only visually inspect welds made on luminaire arms.

Article 5.4 Signal Pole Anchor Rods and Bolts

Furnish 2 inch diameter (nominal) anchor rods for signal poles that meet ASTM F1554 Grade 105, are 96 inch minimum length and conform to Supplemental Requirements; S2, Permanent Manufacturer's Identification, S3, Permanent Grade Identification and S-5 Charpy Impact Requirements. Hot dip galvanize according to AASHTO M232. Use nuts that conform to AASHTO Specification M292 of the grade, surface finish, and style for 2 inch diameter anchor rods. Washers shall conform to AASHTO M293.

Article 5.5 Finishing

Finish the edges of poles and mast arms to conform to the following requirements prior to galvanization in accordance with Section 80.16, Article 16.3 – Galvanizing. Neatly round the following features to the radius specified.

1. On holes through which electrical conductors pass, provide a 1/16 inch radius on both the entrance and exit edges,
2. On pole base plates, provide a 1/8 inch radius on edges along which plate thickness is measured and a smooth finish on all other exposed edges,
3. On the ends of tubes that form slip type joints, complete the following tasks on the two surfaces that contact one another. First, provide 1/16 inch radii on the inside and outside edges of the female and male segments, respectively. Then for the length of the joint plus one half the diameter of the female section grind down welds until they feature a radius concentric with the mating surface and remove material protruding from the two surfaces.

Provide caps to cover the free ends of poles and mast arms.

Article 5.6 Identification Tags

Identify critical information for poles and arms with visible permanent aluminum tags that contain the information shown in the Pole Markings Table. The measurements shown are for illustration purposes only. Use tags large enough to include required information using 1/4 inch high text, 3/8 inch of space between successive lines of text, and at least 3/8 inch of space between the edges of the tag and the text. Secure the tags with two 1/8 inch blind rivets at the base of poles and the underside of mast arms. If furnishing a two piece signal mast arm with slip type joint, mark both pieces with the same message. Provide the holes for the blind rivets before galvanizing.

POLE MARKINGS TABLE

STRUCTURES	MEASUREMENTS	TAG MARKINGS
Signal Poles		
a) Signal mast arm length	45 ft./55 ft.	SMA 45/SMA 55
b) Luminaire mast arm length	22 ft./18 ft.	LMA 22/LMA 18
c) Pole height	36 ft.	PH 36
d) Intersection number (if more than one) -pole number		1 - P 4
e) Sum of signal mast arm moments about centerline of signal pole		SM 4000/SM 3200
f) Design wind speed	100 mph	DWS 100
Light Poles		
a) Luminaire mast arm length	15 ft./15 ft.	LMA 15/LMA 15
b) Pole height	37 ft.	PH 37

Signal Mast Arm			
a)	Mast arm length	40 ft.	SMA 40
b)	Intersection number (if more than one) -pole number		1 - P 4
c)	Sum of signal mast arm moments about centerline of signal pole		SM 3740
d)	Design wind speed	100 mph	DWS 100
Luminaire Mast Arm			
a)	Mast arm length	18 ft.	LMA 18
b)	Pole number (if unique arm design)		P 4

Note:

Italic type indicates additional Tag Markings if poles have 2 luminaire or 2 signal mast arms.

Article 5.7 Plumbing

Plumbing shall be accomplished by adjusting the nuts on the anchor bolts prior to grouting. A slight raking of the pole shall be provided by plumbing the side away from the road. Shims or other similar devices for plumbing or raking shall not be permitted.

Article 5.8 Grouting for Slip-Base Poles

The Contractor shall use a premixed grout having a minimum twenty-eight (28) day compressive strength of four thousand pounds per square inch (4000 psi). Proprietary grout mixtures shall be utilized in accordance with the recommendations of the manufacturer.

Concrete areas to be in contact with the grout shall be cleaned of all loose and foreign matter that would in any way prevent bond between the mortar and the concrete surfaces.

Contractor shall not grout unless ambient temperature will remain a minimum temperature of forty-five degrees Fahrenheit (45°F) for three days after grouting. All improperly cured or otherwise defective grout shall be removed and replaced at the Contractor's expense. No load shall be placed on the grout until it has set for at least ninety-six (96) hours.

For concrete bases, after each post, pole or pedestal is in position, grouting conforming to this Article shall be placed under the base plate as shown on the Drawings, and shaped to present a neat appearance.

Article 5.9 Galvanizing

All signal poles, mast arms, and pedestal poles shall be hot dipped galvanized in accordance with Section 80.16, Article 16.3 – Galvanizing.

Article 5.10 Measurement

Fixed base luminaire poles shall be measured as units complete and in place, including all hardware and all wiring within the poles.

Breakaway base luminaire poles shall be measured as units complete and in place, including frangible couplings, skirt, all hardware, and all wiring within the pole.

Signal mast arm poles and signal breakaway poles shall be measured as complete and installed with all hardware, all wiring within the pole, and either grouting of the base or base plate skirt as appropriate.

Combination signal luminaire poles shall be measured as complete and installed with all hardware, luminaire brackets, all wiring within the pole, and base plate skirt.

Pedestrian push button poles shall be measured as complete and installed with all hardware, all wiring within the pole, and grouting of the base.

All luminaires, luminaire arms, signal heads, pedestrian signal heads, pedestrian pushbutton assemblies, signal mast arms, signs, optical preemption detectors, Pan Tilt Zoom (PTZ) cameras and other equipment on signal poles called for in the Drawings shall be installed and accepted when poles are measured for payment, but shall not be included in payment for poles. These items shall be considered separate pay items, and measured under the appropriate Sections of these Specifications. All other hardware; including wiring within the pole, repair of galvanization when damaged, and grouting of the base; shall be considered incidental to the pay items, and shall not be measured for payment.

Signal and luminaire arms shall be measured as units complete and in place, including labor, equipment, and material necessary to make a complete and functioning unit.

All luminaires, signal heads, signs, optical preemption detectors and other signal equipment on signal and luminaire arms called for in the Drawings shall be installed and accepted when mast and luminaire arms are measured for payment, but shall not be included in payment for mast or luminaire arms. These items shall be considered separate pay items and measured under the appropriate sections of these Specifications. All other hardware, including wiring within the arms, shall be considered incidental to the pay items for signal mast arms or luminaire arms, and shall not be measured for payment.

Article 5.11 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Maintenance, 343-8372 prior to final acceptance. Contact Street Light Maintenance a minimum of three business days prior to delivery. The Engineer retains the right to inspect all poles for conformance with the contract documents prior to accepting delivery. The cost of storage prior to delivery and delivery of these materials is subsidiary to the pay item.

Payment shall be made under the following units:

ITEM	UNIT
Breakaway Base Luminaire Pole (ft Length)	Each
Fixed Base Luminaire Pole (ft Length)	Each

Signal Mast Arm Pole	Each
Combination Signal/Luminaire Pole (MTG Height)	Each
Breakaway Signal Pole	Each
Breakaway Signal Pole, Spare	Each
Pedestrian Pushbutton Pole	Each
Signal Mast Arm (ft Length)	Each
Luminaire Arm (ft Length)	Each

SECTION 80.06 - FIBER OPTIC SIGNAL INTERCONNECT

Article 6.1 Description

This item consists of the work required to furnish and install single mode fiber optic cable in polyethylene conduit between equipment shown on the Drawings along the route indicated. The item includes installing vaults, splicing cable, testing cable, and terminating fibers.

Article 6.2 Referenced Specifications

Complete the following work according to the subsections referenced in each bullet.

- Submit and deliver materials for review and approval according to M.A.S.S. Section 80.01, Article 1.3 Equipment Lists and Drawings.
- The fiber optic cable manufacturer shall submit a letter certifying their products conform to all requirements specified herein.
- Complete all excavation and backfill according to M.A.S.S. Section 80.02 - Excavating and Backfilling. Exception: Polyethylene conduits shall be installed in accordance with Article 6.8 - Construction Requirements for Polyethylene Duct System.
- Remove and replace improvements according to M.A.S.S. Section 80.03 - Removing and Replacing Improvements.

Article 6.3 Certified Fiber Optic Technician

Employ a Fiber Optic Technician that has successfully completed at least one four day "Installation of Fiber Optic Products School." A major manufacturer of fiber optic products shall conduct this school or an Engineer approved independent generic four-day school that encompasses all aspects of fiber optic technician certification.

Only employ those technicians that provide documents proving a minimum two years work experience splicing, terminating, and testing fiber optic cable.

The approved technician shall provide evidence of completed courses within 1 week before the beginning of construction. The Engineer reserves the right to revoke the approval of any technician not demonstrating the skill and knowledge to perform at accepted industry standards or to the quality required in this spec.

Article 6.4 Manufacturer Warranties

Manufacturer's support (customary warranties) period shall be provided for all equipment and materials furnished and installed as part of the fiber optic system, including end equipment (modems, panels, switches etc.). Manufacturer's and Contractor's warranties or guarantees shall be continuous throughout their specified duration and state they are subject to transfer. Submit all warranties, guarantees, and instruction sheets according to M.A.S.S. Section 80.01, Article 1.4 Warranties, Guarantees and Instruction Sheets.

Article 6.5 Polyethylene Duct System

Install polyethylene conduits and vaults in excavated trenches to form the duct system for the fiber optic cable. Polyethylene conduits plowed into place shall not be permitted.

For the polyethylene conduit, furnish a smooth wall, schedule 40, high-density polyethylene (HDPE) pipe that conforms to UL 651 B and features a controlled outside diameter.

Article 6.6 Fiber Optic Cable, General

A current ISO9001 certified manufacturer, who is regularly engaged in the production of fiber optic cable according to these specifications, shall produce all of the fiber optic cable installed on this project. The manufacturer shall not only manufacture the fiber optic cables, but they shall also test and prepare the cables for shipping and provide all connectors needed to complete the project.

Install fiber optic cable approved for use in underground ducts and which conform to:

- United States Department of Agriculture Rural Utilities Service (RUS) standard 7 CFR 1755.900
- Department of Agriculture Rural Electrification Administration (REA) Bulletin 1753f-601 (PE-90) dated August 4, 1994, and these specifications.
- National Electrical Code (NEC) Article 770; NFPA-National Fire Protection Agency
- National Electrical Contractors Association (NECA)/Fiber Optic Association (FOA) 301
- Telecommunications Industry Association/ Electronic Industries Association (TIA/EIA) FOTP-Fiber Optic Test Procedures

References

- ASTM A615, Grade 60.
- Bellcore Testing Requirements GR-771-CORE.
- EIA/TIA-455-82B: Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable (ANSI/EIA/TIA-455-82B-92; Standard Test Procedures for Fiber Optic Fibers.
- NEC 250-1: National Electric Code Grounding.; Article 770 Optical Fibers and Raceways
- Telcordia GR20-CORE: Optical Fiber and Optical Fiber Cable; GR409-Mechanical Requirements for Optical Fiber Cable.
- Telcordia GR-771: Fiber Optic Splice Enclosure.
- TIA/EIA-4720000-A: General Specification for Fiber Optic Cable (ANSI/TIA/EIA-4720000-A-93).
- TIA/EIA-598-A: Optical Fiber Cable Color Coding (ANSI/TIA/EIA-598-A-95).

Use loose tube fiber optic cables with all-dielectric construction, i.e. with no metal armor or conductive material. Optical fibers shall be contained in kink resistant buffer tubes. Each cable shall be equipped with 6 buffer tubes stranded around an anti-buckling central strength member using a reverse oscillation or “SZ” stranding process.

Each buffer tube shall contain 12 optical fibers and shall have an inside diameter much larger than the total diameter of the fiber it supports.

Fillers are allowed in the cable to achieve cable cross-section symmetry.

All cable fibers shall be usable and shall be sufficiently free of surface imperfections and inclusions to meet or exceed the optical, mechanical and environmental requirements contained in this specification.

Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

A. Fibers shall contain no factory splices

Fiber coating shall be a dual-layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically strippable without damaging the fiber.

Repairs to the fiber coatings are not allowed except as determined by the Traffic Signal Maintenance Technician at designated splice locations.

A water-blocking gel shall displace the voids between the buffer tubes and void areas around the individual buffer tubes to prevent water entry. The gel shall be non-nutritive, electrically non-conductive and homogeneous and shall facilitate free movement of the fibers within the tubes such that mechanically or environmentally induced stress on the cable is not induced in the optical fibers. The gel shall be free of dirt or foreign matter and shall be readily removable with nontoxic solvents.

Two (polyester or aramid) yarn binders shall be applied contra-helically with sufficient tension to secure each buffer tube layer to the central strength member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

Use cables that gain tensile strength by using a combination of high tensile strength yarns helically wrapped around the buffer tubes before the application of the outer jacket (sheath). The fiber optic cable shall withstand a maximum pulling tension of 600 lbs during installation (short term loading) with no damage and 200 lbs (long term loading). Tensions on the cables shall not be exceeded under any circumstances.

Furnish cables that use the TIA/EIA-598-B, "Optical Fiber Cable Color Coding" to distinguish individual buffer tubes and optical fibers. During temperature cycling, the coloring compounds shall not fade or smear onto each other or into the gel filling material, and not cause fibers to stick together. The color-coding is as follows:

1. Blue	5. Slate	9. Yellow
2. Orange	6. White	10. Violet
3. Green	7. Red	11. Rose
4. Brown	8. Black	12. Aqua

For cables containing more than 12 buffer tubes, use the color code shown above for tubes 1 through 12, and use stripes or tracers in conjunction with the standard color code for tubes 13 through 24.

Furnish cables with the outer jacket applied directly over the high tensile strength yarns. The jacket shall be free of holes, splits, or blisters. The minimum nominal jacket thickness shall be 55 mils.

The outer jacket material shall be a medium density polyethylene (MDPE) conforming to ASTM D 1248, Type II, Class C, Category 4 or 5, Grade J4 and contain carbon black to provide ultra-violet light protection. The jacket material shall be fungus inert as described in ASTM G 21. The light absorption coefficient, when measured in accordance with ASTM D3349, shall be a minimum of 400 at a wavelength of 375 nanometers.

The cable shall contain at least one ripcord under the jacket for easy jacket removal.

The shipping, storage and operating temperature range of the cable shall be -40 °F to +160 °F.

In each vault, provide the additional length of cable listed in Article 6.9 - Construction Requirements for Fiber Optic Cable.

All cable markings shall be approximately 1/8-inch (3 mm) nominal height, clearly legible and distinguishable, and made at 2-foot intervals to be used as length markers. If initial markings fail to meet marking criteria, i.e. illegible, incorrect spacing, spelling error, etc., cables may be remarked to meet criteria. Cable markings shall include:

- Cable ID
- Sequential numbers in whole foot or meter intervals to determine the length of the cable and amount remaining on the reel.
- Number of fibers
- "SM" (for Single Mode Fiber)
- "MOA Fiber"

B. Fiber Optic Drop Cable

Drop Cable is defined as the assembly or pigtail consisting of fiber optic cable, connectors, protective tubing and fan-outs (if required) and all incidental materials used for connectivity between a fiber trunk cable and field devices, i.e. signal controller, modems, etc.

Cable design and installation shall meet requirements for outdoor use as described in Article 6.6 - Fiber Optic Cable, General.

Optical jackets (3mm), where used, shall be yellow for single mode fibers.

No splices are allowed within the cable length.

Drop cables shall be factory assembled.

Non-connectorized ends shall be suitable for heat fusion splicing as described in the Article 6.9, subsection Splices.

The manufacturer shall provide factory-testing information of each fully assembled fiber optic drop cable for each connector/fiber on tags attached to the individual or paired connector/fiber.

Drop cables shall be packaged individually within a plastic package marked clearly with the manufacturer's part number. Drop cables shall be a factory assembled SM fiber pigtailed splice cassette with 12 or 24 fiber LC UPC duplex connectors. Drop cable assembly housing shall be manufactured by Corning or an approved equal.

Field testing information of each Fiber Optic Drop cable (fully assembled) shall in accordance with Article 6.09 – Construction Requirements for Fiber Optic Cable, subsection, Field Testing and Performance of Fibers. Documentation of testing shall be in accordance with subsection, Documentation of Testing.

Fiber optic drop cables shall be equipped with:

1. Twelve (12) optical fibers or number as specified in the plan.
2. Fiber optic connectors that are:
 - a. compatible with the equipment being used for fiber strands with preset usage.
 - b. in accordance with subsection, Connectorization.
 - c. factory installed unless otherwise allowed by the Engineer.
3. Drop Cable Fan-out Kits that feature the heavy duty Spider design. Install fan-out kits for all connectorized ends to build up to 3 mm jacket.
4. Tubing that is 900 μm or 3 mm fanout as required by the application.
5. Buffer tubes protected by the cable sheath or fan out kit. Exposed buffer tubes are not acceptable.
6. Individual fiber strands protected by aramid fiber tubes.
7. Minimum tubing length: no requirement for this project.

C. Single Mode Optical Fibers

Single Mode (SM) fibers utilized in the cable shall be fabricated from 100 kpsi proof stress glass and primarily composed of silica which shall provide a matched clad index of refraction (n) profile and the following physical and performance characteristics:

1. Core Diameter: 8.3 μm
2. Maximum Attenuation: 0.4/0.25 dB/Km at 1310/1550 nm, respectively.
3. Maximum Dispersion: ≤ 3.2 psec/nm-km from 1285 nm to 1330 nm; ≤ 17 psec/nm-km at 1550 nm.
4. Dispersion Wavelength (ZWD): 1301.5 to 1321.5 nm
5. Zero Dispersion Slope: 0.092 ps/nm²-km
6. Cladding Diameter: 125 +/- 1.0 μm
7. Core-to-Cladding Offset (concentricity): ≤ 0.8 μm

8. Cladding Non-Circularity: $\leq 1.0\%$
9. Fiber Coating Diameter: 245 +/- 10 μm
10. Secondary Coating: 900 μm (as specified for breakout cable/kits, distribution cable, pigtails and patch chords only)
11. Fiber Colored Diameter: 250 +/- 10 μm nominal
12. Mode-Field Diameter: 9.3 +/- 0.5 μm at 1310 nm; 10.5 +/- 1 μm at 1550 nm
13. Attenuation Uniformity: No point discontinuity greater than 0.10 dB at either 1310nm or 1550nm
14. Cutoff Wavelength: <1260 nm
15. Maximum End-to-End Attenuation per cable length: 15dB
16. Maximum cable outside diameter: 0.5 inch
17. Fiber Polarization Mode Dispersion (PMD): 0.5 psec/ km^{1/2}
18. Proof Test: All Optical fibers shall be proof tested by fiber manufacturer
19. Attenuation at Water Peak: The attenuation at 1383 \pm 3 nm shall not exceed 2.1 dB/km.
20. Numerical Aperture: 0.13.

D. Testing and Performance by Manufacturer

All outdoor cable installations shall meet or exceed the requirements of the Fiber Optic Test Procedure criteria referenced in RUS 7 CFR 1755.9 and Bulletin 1753f-601 (PE-90) and these specifications.

The following requirements apply to the referenced Fiber Optic Test Procedure (FOTP):

1. TIA-455-3-A, FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components": The average change in attenuation at extreme operational temperatures (-40° F to +160° F) shall not exceed 0.05 dB/km at 1550 nm for single-mode fiber. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm.
2. When a one-meter static head or equivalent continuous pressure is applied at one end of one-meter length of unaged cable for 24 hours, no water shall leak through the open cable end. When a one-meter static head or equivalent continuous pressure is applied at one end of one-meter length of aged cable of one hour, no water shall leak through the open cable end. The aging cycle is defined as exposing the cable to 85° C for 168 hours and two cycles of -40° C to +70° C with cable held at these temperatures for 24 hours. At the end of this cycle, the cable will be decreased to +23 °C and held for 24 hours. The water penetration test is completed at the end of the 24-hours hold. Testing shall be performed in accordance with the industry standard test, TIA-455-82-B, FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable".

3. TIA/EIA-455-81-B, FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable": the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at +65° C.
4. TIA/EIA-455-41-A, FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables": Ten percent of the fibers shall not experience a magnitude of attenuation change greater than 0.1 dB at 1550 nm (single mode fiber). The magnitude of the attenuation change shall be within the repeatability of the measurement system for the remaining 90% of the test fibers; the repeatability of the measurement system is typically 0.05 dB or less. No fibers shall exhibit a measurable change in attenuation after test load is removed.
5. TIA/EIA-455-104-A, FOTP-104, "Fiber Optic Cable Cyclic Flexing test": Change in attenuation shall not exceed 0.1 dB at 1550 nm for single mode fiber. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers; the repeatability of the measurement system is typically 0.05 dB or less. The remaining 10% of the fibers shall not experience an attenuations change greater than 0.1 dB at 1550 nm (single mode fiber). The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.
6. TIA/EIA-455-25-C FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies": The magnitude of the attenuation change shall be within the repeatability of the measurement of 90% of the test fibers; the repeatability of the measurement system is typically 0.05 dB or less. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single mode fiber). The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.
7. TIA-455-33-A FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test": While subjected to a minimum load of 600 lbf, the cable sample shall be able to withstand a twist of 360 degrees in less than 3 meters of length. The magnitude of the attenuation change shall be within the repeatability for the measurement system for 90% of the test fibers; the repeatability of the measurement system is typically 0.05 dB or less. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single mode fiber). The cable shall not experience a measurable increase in attenuation when subjected to the rated residual tensile load, 200 lbf.
8. TIA/EIA-455-85-A FOTP-85, "Fiber Optic Cable Twist Test": The magnitude of the attenuation change shall be within the repeatability for the measurement system for 90% of the test fibers; the repeatability of the measurement system is typically 0.05 dB or less. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single mode fiber). The average increase in attenuation for the fibers shall be <0.40 dB at 1300 nm. The cable jacket shall exhibit no cracking or splitting under a 5x magnification after completion of test.

E. Packaging

Fiber optic cables shall be shipped on wooden reels. The diameter of the drum shall be a least 20 times the diameter of the cable.

The following information must be either stenciled on the reel, on a weatherproof tag firmly attached to the reel or a combination of both in order to trace the manufacturing history of the cable:

1. Optical Cable
2. Number of Fibers
3. Date cable was tested
4. Non-armored
5. Year of cable manufacture
6. Name of cable manufacturer
7. Gross weight
8. Part Number
9. Handling Instructions
10. Arrow indicating cable wind direction

Furnish the Engineer, who shall provide copies to the MOA Traffic Department, cable data sheets that contain the following information:

1. Manufacturer Name
2. Cable ID Number and fiber type
3. Factory Order Number
4. Cable Length
5. Factory measured attenuation (each fiber)
6. Index of Refraction
7. Bandwidth Specification (where applicable)

Sufficient cable length, in addition to the quantities shown on the plan, shall be provided for testing. Both ends of the cable shall be available for testing. Pack one continuous length of fiber optic cable per reel; maximum overage shall not exceed 10% unless approved by the Engineer. Compensation shall not be granted for overage or excess cable needed for testing and installation methods.

Package the cable for shipping to prevent the cable from coming loose in transit. Secure the outer and inner end of the cable. Cover the reel with thermal wrap to protect the cable. Apply end seals to each end of the cable to prevent moisture and from entering the cable. Project the inner end of the cable a minimum of 6 ft into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner to make it available for testing.

Include the manufacturers test documentation with each reel. This documentation indicates the attenuation of each cable fiber in dB/km (dB/ft), measured at 1310 nm and 1550 nm for single mode fiber.

Mark each reel to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

F. Connectorization

Connectors: Furnish and install connectors (in-line or terminated ends) or attenuators as required in the Drawings or as required to provide a fully operational fiber optic system.

Hybrid adaptors shall not be used to connect two different connectors. Instead, complete the interface using jumper cables with connectors that match the two incompatible connectors.

A Certified Technician, as described in these specifications, shall install all connectors.

Connectors shall be LC connectors to assure compatibility with equipment as required for fibers with a preset usage and approved by the Engineer.

Ceramic ferrules shall be provided for all fiber optic connector applications. Install connectors per manufacturer application and recommendations, including proper termination to the outer tubing (900 micron, 3 mm fan-out) as required by the application.

Connectors shall be rated for operating temperatures of -40 °F to 160 °F.

Connectors shall be factory-installed for all applications except where approved by the Engineer.

Connectors shall be installed with ceramic ferrules with fibers secured within ferrule with epoxy, heat set or air dried, as specified by the manufacturer; machine polished mating faces shall be provided.

Boots shall be provided for durable cable strain relief.

Dust caps shall be provided and installed at all times when connector is not in use.

If connections are made, connectors shall be cleaned once prior to the first connection and once every time thereafter prior to reconnection. Connectors shall be cleaned according to manufacturers recommended practice.

Connector losses shall not exceed limits as described in Article 3.09 – Construction Requirements for Fiber Optic Cable, subsection, Field Testing and Performance of fibers.

Repeatability of keyed connectors shall not exceed 0.2 dB.

G. Attenuators

Attenuators shall be provided at no extra payment to the Contractor to achieve the desirable signal losses at the receiving end equipment (modems, etc.). Attenuators shall only be installed on the receiving end closest to the originating transmission.

Connecting ends shall be compatible to connectors described in subsection, Connectors.

H. Splice Closures

Fiber optic splice closures (FSC) shall be installed in the locations on the plan at designated splice locations. Closures shall contain splice trays or organizers that contain the splices.

Prior to installation, the Contractor shall provide certification from the manufacturer that the splice closures conform to the specifications and test procedures.

Splice closures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress and flex temperature extremes as demonstrated by successfully passing factory test procedures and these specifications. The closure shall prevent the intrusion of water without the use of encapsulates.

Closure re-entry and subsequent reassemble shall not require specialized tools or equipment; these operations shall not require the use of additional parts.

Splice closures shall provide housing and storage for all splices, stripped cable and undisturbed buffer tubes. All splices enclosures shall provide protection and strain relief to optical fibers.

Splice closures shall be suitable to handle straight, butt or branch splices.

Closures shall be provided with external valve pressurization ports.

Closure shells shall be glass-filled high-density thermoplastic that effectively withstands corrosion, high impact, and freeze thaw stresses.

Closure endplates shall be interchangeable with each size of closure available from the closure supplier.

Where additional access is required into an existing splice closure, replace the existing endplate with an endplate suitable for the task.

Splice closures must accept up to six cables in a butt configuration and 12 for in-line configuration without special adaptors.

Closure shall contain a permanent neoprene gasket seal.

All closures, including closing hardware, shall be from the same supplier.

External Shrader valve pressurization port shall be supplied.

The splice case shall be designed and equipped with the necessary mounting hardware to be attached to the side of the manhole or vault, and to be suspended with sufficient clearance at each end for acceptable cable bends.

All cables shall be properly dressed and affixed to rails or racks within the manhole or vault. No cables or enclosures shall be permitted to lie on the floor.

Fiber optic cables shall be restrained within the splice enclosure such that there is no discernible tensile force on the optical fiber.

The splice closure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or unspliced fiber. Splice organizers shall be re-enterable and re-sealable.

The closure shall be capable of accommodating splice organizer trays that accept mechanical, fusion, or multi-fiber array splices.

Splice cases shall hold a minimum of 2 splice trays with a maximum of number of splice trays to hold up to 96 splices.

One splice tray shall be designed to hold a minimum of 12 mechanical splices. A second splice tray (for Fiber Optic Drop Cable splicing) shall be designed to hold a minimum of 12 fusion splices. All other splice trays provided in the closure shall be designed to hold fusion splices of 12 (typical) up to 36 splices. Total number of splices supported shall be 96 splices.

Splice trays shall allow for optical fiber storage as recommended by the manufacturer.

The splice closure shall have provisions for controlling the fiber bend radius (1.5 inches typical) to a minimum as required by the manufacturer.

Splice closure shall contain a basket allowing fiber buffer tube storage of exposed buffer tubes.

The splice case shall be UL listed for use in wet locations.

The closure shall be installed according to the manufacturer's recommended guidelines.

- I. Splice Closures -Factory Testing Requirements: The construction and testing of the fiber optic splices and splice enclosures shall comply with all applicable industry standards including: Electronic Industry Standards (EIA/TIA), ANSI and ASTM standards.

Compression Test: The closure shall not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 300 lbf (1335 N) at temperatures of 0 °F and 100 °F (-18 °C and +38 °C). The test shall be performed after stabilizing at the required temperature for a minimum of 2 hours. It shall consist of placing an assembled closure between two flat paralleled surfaces, with the longest closure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

Impact Test: The assembled closure shall be capable of withstanding an impact of 21 ft-lbf (28 N-m) at temperatures of 10 °F and 100 °F (-12 °C and 38 °C). The test shall be performed after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of a 20 lb (9 kg) cylindrical steel impacting head with a 2-inch (5 cm) spherical radius at the point where it contacts the closure. It shall be dropped from a height of 12 inches (30 cm). The closure shall not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

Cable Gripping and Sealing Testing: The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550nm when attached to the cables and the closure assembly. The test shall consist of measurements from six fibers, on from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers, before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

Vibrations Test: The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA standard FOTP-11, Test condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

Water Immersion Test: The closure shall be capable of preventing a 3 meter (10-foot) waterhead from intruding into the splice compartment for a period of 7 days. Testing of splice closure is to be accomplished by the placing of the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Apply continuous pressure to the vessel maintain a hydrostatic head equivalent to 10 ft (3 m) on the closure and cable. This process shall be continued for 7 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

Certification: It is the responsibility of the Contractor to ensure that either the manufacturer, or an independent testing laboratory has performed all of the above tests, and the appropriate documentation has been submitted to the Engineer. Manufacturer certification is necessary for the model of closure supplied. It is not necessary to subject each supplied closure to the actual tests described herein.

Article 6.7 Communications Vaults

Work under this item consists of installing communications vaults with bolt on lids according to the details shown in the Drawings and as specified in the following.

Shall be spaced at interval no greater than 2,500 feet (800-1,000 feet typical). In extreme cases where conduit has no bend, as permitted by the Municipal Traffic Engineer or designee, 5,280 feet is allowable (conduit shall be lubricated with no bends).

Shall be installed at locations prior to exceeding 360 degrees cumulative conduit bends, measured from the last vault.

Vaults are not required for change in conduit installation method.

Each vault shall consist of two sections that stack one atop the other and a lid that features nominal dimensions of 30-inches by 48-inches. The top and bottom sections shall measure 24 and 36-inches tall, respectively, and with a 3-inch overlap, shall provide an effective height of 57-inches. The vault shall have an open base.

The vault lid shall have a minimum design load of 15,000 pounds and include two pull slots, each 1/2-inch wide by 4-inches long. Furnish lids with a permanently recessed logo that reads "TRAFFIC". The lid surface shall have a coefficient of friction of 0.50 according to ASTM C 1028. Lids shall meet the Heavy Duty requirements of AASHTO M306, Drainage, Sewer, Utility, and Related Castings.

Furnish lids that contain steel rebar or mesh pieces completely encased within the lid to enable locating the vault with a metal detector. Provide lids with a minimum 1-inch of cover over the steel. Lid construction shall preclude the need to ground the lid.

Furnish vaults and lids that are gray in color and constructed of the polymer concrete material, "cosmopolite".

To keep water from entering the vault, install manufacturer-approved gaskets in the two joints in the vault: between sections and between the lid and the top section.

Furnish vaults with lids that can be bolted down with two 3/8-inch 16 UNC stainless steel pentahead bolts. Install the pentahead bolts and stainless steel washers upon acceptance of the completed fiber optic cable interconnect system.

Furnish each vault with brackets that support the length of fiber optic cable and any splice enclosure required in the vault. Furnish brackets recommended by the manufacturers of the fiber optic cable and splice enclosures. Furnish brackets made from corrosion resistant materials and anchor them with stainless steel hardware. These brackets shall be incidental to the communications vault.

The stainless steel hardware used to attach the fiber optic cable support assembly shall not fully penetrate vaults to prevent water intrusion.

Furnish vaults with conduit openings machined at the time of fabrication as shown on the vault detail sheets, or punch-driven at the time of placement. Size each opening to accommodate the conduit called for in the Drawings.

Furnish vaults with one 5 3/4-inch diameter knockout for future multiduct installation in those walls with one or no conduits. The knockouts shall be aligned across from each other to the extent possible

Article 6.8 Construction Requirements For Polyethylene Duct System

Install polyethylene conduits at least 36-inches below finished grade in trenches separate from those used to install the traffic signal and highway lighting systems.

Install clean conduits that remain free of water and earthen materials during and after installation. Before removing polyethylene conduits from their reels, install expandable rubber plugs in the conduit ends. When conduits are cut, install expandable rubber plugs in all exposed conduit ends.

Install one-piece conduits between vaults. Fuse shorter sections together according to the conduit manufacturer's written instructions. The Department shall not accept mechanical connectors for joining shorter sections of conduit together.

Install the polyethylene duct system without using elbows. Run the HDPE pipes straight through vault walls as detailed in the attached vault details sheets. After fully backfilling the conduit trenches and backfilling around the vaults, trim the HDPE pipes to protrude 50 mm inside the vault wall. Reinstall the expandable rubber plugs in the conduit ends.

Mark underground ducts with a continuous strip of polyethylene marker taped four mils thick and six-inches wide. Furnish orange marker tape with a black legend that reads "CAUTION FIBER OPTIC CABLE BURIED BELOW". Install the tape 24-inches ±three inches below finished grade.

Keep junction boxes and conduit ends covered until you begin pulling conductors. After installing the fiber optic cable, install special termination kits, recommended by the conduit manufacturer, to seal the conduits from contamination, rodents and flooding. Kits shall be designed to fit the number and size of cable(s) within the conduit and shall allow cable entry and exit within vaults or manholes without inducing stress on the fiber optic cable or damaging cable jacket.

Install a 12 AWG stranded copper locate wire furnished with orange insulation in each HDPE conduit in system. The locate wire shall be approximately 10 feet longer than the run of conduit. All locate wires entering vaults shall be electrically connected together to provide a continuous locate signal throughout the conduit system for locating purposes.

A polyethylene pull rope shall be installed in all spare conduits for future cable installations. The rope shall be rated for 1,000 lbs or greater and shall not be less than ¼ inch in diameter.

Install conduit marker posts at each vault and on approximate 400 feet centers. Each marker shall consist of a two inch perforated steel tube that supports a one-foot square, four line sign that reads "CAUTION FIBER OPTIC CABLE BURIED BELOW" in one inch tall series B lettering and a double headed arrow.

Article 6.9 Construction Requirements For Fiber Optic Cable

Cable installation in conduit (duct) systems shall conform to Corning Cable Systems procedure SRP-005-011, "Fiber Optic Cable Placing-Duct", or manufacturer approved methods of jetting or pulling.

Submit a detailed construction plan and installation procedure for the Engineer's approval before cable installation.

Cable shall only be spliced in vaults where drop cables are required to route fiber into controller cabinets.

Only a certified technician, meeting the requirements of Article 6.3 - Certified Fiber Optics Technician, shall complete the following work: cutting of fiber optic cable, if required, and all splicing, testing, and terminating of optical fibers.

All fibers should be tested upon receiving cable. The Contractor shall assume full responsibility to cable that is damaged if testing is not performed after receiving cable.

Before removing cable from a reel, remove all nails, staples and other materials that might kink or damage the cable when it is unreeled.

Inspect all cables before installation to ensure they are free of damage (nail or staple holes, jacket tears, kinks etc.), material and manufacturing defects, and dimensional non-uniformities that would:

- Interfere with the cable installation using accepted cable installation practices.
- Degrade the transmission performance and environmental resistance after installation.
- Inhibit proper connection to interfacing elements.
- Otherwise yield an inferior product.

Record the physical condition of the cable as outlined in subsection, Documentation of Field Testing.

Take all necessary precautions to protect reeled cable from possible damage while unattended.

Cable shall not be kinked or forced abruptly against conduit edge when pulling cable from conduit ends. Cable feed systems (reels, rollers, guide, tubes etc.) must be used to install or retrieve cable from conduit ends in vaults, manholes or junction boxes.

When cable is installed by pulling, use a swivel and woven cable grip designed for fiber optic cable. Materials for lubricating shall be utilized when pulling.

Fiber optic cable lengths greater than 100 ft shall not be coiled in one continuous direction. Lengthy cables requiring multiple pulls shall be coiled in a "figure-eight" pattern at intermediated access points to avoid twisting of cable unless cable is assisted by jetting or winching. The figure-eight patterns shall be approximately 15-feet in length. Cardboard shims shall be installed between cable layers at the crossover of the "figure eight" to relieve pressure on the cable.

Cable shall be pulled in one continuous run. Splices are only allowed at the designated locations.

When a conduit run contains two or more cables, pull each cable individually when 2 or more 90° bends occur in the run. One continuous cable pull shall not contain more than one 90° bend.

When you are installing cables, monitor the tensile forces in the cable using equipment manufactured for this purpose. Monitoring equipment shall record the maximum tension incurred during each pull.

Replace, at your expense, all cable runs subjected to one of the following conditions:

- Recorded tensions exceeded the maximum tension of 600 lbs during pulling,
- Cables were bent to a radius less than 20 x diameter of the cable during pulling,
- Cables were bent to a radius less than 10 x diameter of the cable when they are coiled into the figure-eight pattern or otherwise handled.

Protect exposed cable from damage at all times.

If cable ends are exposed and unattended, cable caps shall be taped onto cable ends to prevent ingress of moisture into the cable. If the duration of the exposed cable end is short, several wraps of tape shall be provided on the cable end.

Temporary aerial installation methods shall be consistent with Corning Cable Systems SRP-005-010, "Fiber Optic Cable Placing-Lashed Aerial" or a manufacturer approved methods.

Furnish the following lengths of slack cable at the locations indicated:

- 100-feet per splice vault
- 65-feet per non-splice vault
- 6-feet per controller/computer cabinet.

Neatly coil slack cable around the inside perimeter of manholes, vaults and junction boxes on cable brackets. Cable slack shall be supported as to not interfere with access into manholes, vaults or junction boxes.

Manufacturer minimum bend radii for loaded and unloaded conditions shall be exceeded in all circumstances. If radii information is not available, minimum bend radii shall not be less than 20 times the diameter of the cable when loaded or 10 times the diameter of the cable unloaded (at rest).

All fiber optic cable shall be installed with marking tape, copper wire tracer and above ground markers as required in Article 6.8 Construction Requirements For Polyethylene Duct System.

A. Splices

A Certified Technician as described in these specifications shall perform all splicing and termination of optical fibers.

Two weeks prior to the start of the fiber optic cabling installation, the Contractor shall submit the following: proposed locations of the mainline spliced points for review by the Engineer; the proposed process to be used for splicing including procedure, cleave tool and specific fusion splicer to be used.

Splicing shall only be allowed in areas as designated on the Drawings or as approved by the Engineer.

All splices and stripped cable shall be housed in a splice closure.

Mainline splices shall consist of end-to-end fusion splices for all fibers within the fiber optic cable where designated in the Drawings.

Drop fiber splices (6 fiber typical) and drop cables (6-fibers typical) shall be used for connectivity between a primary mainline fiber optic cable and field devices (i.e. traffic signal controller cabinet) as identified in the Drawings.

Drop fiber splices shall consist of breaking out the required buffer tube(s) from the fiber optic trunk cable and fusion splicing the appropriate number of fibers to the fiber optic drop cable (6 fibers typical). Remaining undisturbed fibers, if any, shall be protected in the splice tray. End-to-end fusion splicing shall be conducted for any disturbed fibers within the disturbed buffer tube(s). Remaining buffer tube(s) that are not required for splicing shall be undisturbed and protected in the Splice Closure.

Splicing (drop splice) shall be performed for each device location at locations shown on the Drawings. Splicing shall be performed as per Corning Cabling Systems Recommended Procedure SRP-004-013, Mid-Span Access of Fiber Optic Cable (Cable Slack Present), or an equivalent manufacturer's recommended procedure approved by the Engineer.

Cable ends involved in splicing shall match colors of the fibers and buffer tubes to the extent possible.

Fiber splices shall be contained within fiber splice closures (FSC) in designated locations shown on the Drawings.

All splices shall be fusion splices protected with a heat shrink sealant (RTV fusion splices). Mechanical splices are not allowed.

Fusion splices shall be made with a portable fusion splicer. The unit must be able to splice fibers specified in these with 250 micrometer coating and 900 micrometer coating with little or no modification in the field.

End-to-End splicing shall be performed per written manufacturer instructions for the supplied splice closure units.

No stresses shall be placed on the fibers before or after the splice is completed.

Splice loss shall not exceed the limits described in subsection, Field Testing and Performance of Fibers.

Fan-out kits are required for splices to multiple fibers in the buffer tubes for single mode fiber (NCHRP).

Splices shall be located in the center of the slack cable in junction boxes, manholes or vaults.

B. Field Testing and Performance of Fibers

A Certified Technician, as described in subsection, Certified Fiber Optic Technician, shall perform all testing of optical fibers.

All fibers should be tested upon receiving cable. The Contractor shall assume full responsibility to cable that is damaged if testing is not performed after receiving cable.

Physical condition of the cable shall be recorded as outlined in subsection, Documentation of Field Testing.

The Contractor shall schedule the date, time and location of all tests required by this specification with MOA Traffic Personnel (907-343-8355) 72 hours before performing the tests. MOA Traffic personnel shall be present when the tests are conducted. The certification technician shall demonstrate clearly how the tests are being performed and shall be made available to discuss testing strategies with MOA personnel.

Tests shall be conducted using standard operating procedures as defined by the manufacturer of the test equipment.

The following tests shall be conducted after the cable has been installed, spliced and connectorized. Test results shall be submitted in accordance with subsection, Documentation of Field Testing (NCHRP). Tests shall be performed before making permanent equipment connections. All fibers shall be tested for continuity, events above 0.05 dB and total attenuation of the cable. If the fiber optic cable installed is connected to an existing fiber optic cable, perform installation tests the installed cable and all existing fibers to which it is spliced or connected:

1. End-to-end Optical Time Domain Reflectometer (OTDR) testing shall be conducted to identify attenuation associated with each fiber. Traces shall be provided for each operational wavelength for the type of fiber in the system to indicate attenuations and their locations.

A Certified Technician utilizing an OTDR and Optical Source/Power Meter shall conduct the tests after installation. The Technician shall conduct the test according to the standard operating procedure as defined by the manufacturer of the test equipment.

To eliminate or shift the “dead zone”, either a factory patch chord or “fiber launch box” of length greater than the dead zone shall be used.

Measurement shall be conducted for 1310 and 1550 nm for single mode fiber.

2. Attenuation Test: All fiber links shall be tested with a standard power-meter test and all attenuation shall be documented.

For every fiber installed or connected to under this Contract, perform end-to-end attenuation test. For the test, use a calibrated optical source and power meter using the standard three-stage procedure. Determine acceptable link attenuation by the cumulative value of standard losses based on length, number and type of splices and connectors.

Fiber optic cable loss limits shall be in accordance with the following; The Engineer may elect to allow bi-directional averaging of OTDR testing due to splice loss core alignments:

No event shall exceed 0.10 dB. If any event is above 0.10 dB, repair or replace that event location.

Total dB loss of a cable fiber less events shall not exceed +3% of the factory test or 1% of the manufacturer’s published production loss at 1310 and 1550 nm. Cable fiber loss shall not exceed Maximum Attenuation Limits as defined in subsection, “Single Mode Fiber Optic Cable”.

$$\text{Cable Fiber Loss (dB)} = \text{Total Loss (dB)} - \sum \text{events (dB)}$$

$$\text{Cable Fiber Loss (dB/km)} = \frac{\text{Cable Fiber Loss (dB)}}{\text{Cable Fiber Length (km)}}$$

Where total or event losses exceed these specifications, replace or repair that cable run and assume all expenses, both labor and materials. Elevated attenuation due to exceeding pulling tension during installation shall require replacement of cable at no expense to the Department.

Fusion splice losses shall not exceed 0.10 dB per fiber. Mechanical splices, where allowed, shall not exceed 0.30 dB.

Each connector, after factory assembled, shall not exceed the maximum loss of 0.50 dB (typical loss is 0.25dB) and optical return reflective loss of <-0.45dB.

If event losses exceed these specifications, event locations shall be replaced or repaired without additional cost reimbursement for expenses.

If total loss exceeds these specifications, Fiber Optic cable shall be replaced or repaired without reimbursement for expenses.

All fibers within the cable shall be usable.

C. Documentation of Testing

Upon completion of the field tests, the Contractor shall provide three copies of all documentation to the Engineer.

Except for standard bound materials, documentation shall be neatly bound in 8.5" x 11" (size A4) documentation in logical groupings. Bindings shall be of either the 3-ring or plastic slide-ring type. Permanently and appropriately label each such bound grouping of documentation.

Documentation from manufacturer shall include manufacturer data of cable and fiber including: Optical performance (OTDR) including dB/km loss measured at 1310 and 1550 nm for single mode, manufacturer's name, date of manufacture, Index of Refraction, cable ID, connector losses and bandwidth/dispersion data.

Documentation of field testing shall include a map of the cable part numbers, manufacturer, cable length markings, as-built cable routing map, location of splice points and hardware at each splice point location (see below under testing also). Documentation shall include the information below for end-to-end testing, splice loss measurements, OTDR traces.

The documentation shall be neatly tabulated for each field test and shall include the following:

1. Cable and Fiber Identification:

Manufacturer

Operator Name

Cable ID

Date and Time

Fiber ID (tube and fiber color)

Date of Installation

Cable Location (begin and end point)

Fiber Count

Cable (ie single mode, loose tube, OSP, OFNG, etc.)

2. Setup Parameters

Wavelength

Range (OTDR)

Pulse Width (OTDR)

Scale (OTDR)

Refractory Index (OTDR)

Jumper and/or Launch Box Length

3. Test Results

a. OTDR Test:

Total Fiber Trace (mile)

Total Length

Splice Loss/Gain

Events \geq 0.05 dB

Measured Cable Length (Cable Marking)

Backscatter

Provide traces on CD/USB to Engineer

b. End to End Attenuation Test

Length, Number, and type of splices and connectors

Length Attenuation

Fiber optic cable test results shall demonstrate that dB/km losses do not exceed limits specified in subsection, Field Testing and Performance of fibers.

Submit to the MOA and maintain on file a current calibration certificate for the OTDR being used.

Article 6.10 Construction Requirements For Communications Vaults

Do not install vaults in or near the ditch bottoms, in areas that collect drainage, or where vehicular traffic is anticipated. If you cannot avoid installing a vault in a broad area that collects drainage, install the top of the vault one foot higher than the drainage outlet and fill around the vault with Type II-A Classified Fill and Backfill placed on a 4:1 slope.

To the extent possible, install vaults at the locations shown on the Drawings. If a vault needs to be moved, the distance between adjacent vaults shall not exceed 1000 feet.

Under all vaults, place a 48-inch by 66-inch sump that is 12-inches thick and consists of coarse concrete aggregate material of a minimum depth of 18 inches.

Finish grade shall be in accordance with pertinent sections of Article 8, Junction Boxes.

After installing the conduits, fill the gaps between the conduits and the sides of conduit openings with a self-curing caulking that provides a permanent, flexible rubber that is unaffected by sunlight, water, oils, mild acids and alkali. The cured compound shall be mildew resistant, non-flammable, and gray in color. The material shall provide a permanent bond with the polymer concrete. Allow caulking to fully cure per the manufacturer's written installation instructions before placing backfill around the vault.

Install the fiber optic cable support assemblies according to the vault manufacturer's written instructions.

Article 6.11 Method Of Measurement

The Engineer shall measure the accepted quantities of polyethylene conduit by the linear foot measured on the alignment and slope of a straight line that connects the centers of adjacent vaults and controller cabinet.

The Engineer shall measure the accepted quantities of fiber optic cable using the distances measured between vaults for conduit payment and add the slack cable installed in the vaults.

The Engineer shall measure the accepted quantities of communications vault on a per each basis.

Article 6.12 Basis Of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment for HDPE conduit shall be full payment for furnishing and installing all materials, including plugs, locating wire, and marker posts and all excavation, backfilling, and disposal of surplus material; and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for fiber optic cable shall be full payment for furnishing and installing all materials, including drop cables, splice closures; and for all labor, tools, equipment and incidentals necessary to complete field tests and splicing.

Payment for each communications vault shall be full payment for furnishing and installing all materials, including, lids, gaskets, pentahed bolts, washers, fiber optic cable support assembly with stainless steel mounting hardware, caulking, and coarse concrete aggregate; for all excavation, backfilling, and disposal of surplus material; and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment shall be made under the following units:

ITEM	UNIT
Communications Vault	Each
HDPE Conduit	Linear Foot
Fiber Optic Cable	Linear Foot

SECTION 80.07 CONDUIT

Article 7.1 General

Contractor shall run electrical conductors in conduit, except for overhead wiring, wiring inside poles and when otherwise called for in the Drawings. All conduit and fittings shall be galvanized, rigid type manufactured of mild steel or wrought iron conforming to U.L. Underwriters Laboratory Standard UL-6 and hot dip galvanized in accordance with American National Standards Institute specification ANSI C-80.1. If called for in the Drawings, rigid non-metallic type conduit shall conform to the applicable UL Standard UL-651 or UL-651A. Only one type of conduit shall be used in any one run from one junction box to another. Where non-metallic conduit is to be installed, the conduit runs between a load center and the nearest junction box shall be of the rigid metal type.

Conduit and fittings to be installed on the surfaces of poles or in structures and foundations shall be rigid metal type as specified above for underground installations.

Couplings for new rigid metal conduit shall be threaded. Where existing conduit is intercepted and extended, twist-on compression type couplings shall be allowed. Set-screw couplings are not allowed on the project.

Conduit in foundations for ground rods shall be one inch (1") diameter.

Contractor shall join conduits together with standard threaded couplings using a pipe wrench to ensure tight joints. Tapered or universal fit plugs are not acceptable for final usage. Provide NPT threads on the ends of all shop and field cut conduits. Slip joints and straight threads shall not be used. Cut conduits with a rolling pipe cutter to ensure a square end and proper threading. Before threading, ream the cut ends to remove the sharp edge and all burrs. Thread the ends to within one thread of the factory threaded length and then paint the cut end and threads with a zinc rich paint overlapping the original galvanized finish. Galvanized coatings that have been cut or damaged shall be repaired in conformance with Section 80.16.3 - Galvanizing.

Until wiring is started, all conduit ends shall be capped with standard pipe caps or approved plug and coupling combinations. When caps are removed, the threaded ends shall be provided with approved conduit grounding bushings.

Contractor shall lay conduit to a minimum depth of thirty inches (30") below finished grade. See Division 20, Section 20.13 - Trench Excavation and Backfill for backfill requirements.

Clean all debris and moisture out of conduits before installing conductors or cables.

If the conduit is for thaw wire only, then:

1. Fittings for use in below-grade storm drains shall be suitably rated as NEMA 7, complete with gaskets for watertight installations.
2. Provide suitable conduit seals and sealant to make connections to junction boxes installed with manholes watertight.
3. Junction boxes for installation in manholes shall be NEMA Type 7, with gasketed covers for watertight installations.

4. Couplings and all threaded connections shall be provided with Teflon tape or approved water treatment applied to threads before tightening.

Bottom of trenches for non-metallic conduit shall be relatively free of sharp irregularities which would cause pinching and excessive bending of the conduit. The first six inches (6") of backfill shall be free of rocks exceeding the one inch (1") maximum dimension.

Conduit entering the bottom of concrete junction boxes shall terminate with a ninety degree (90°) sweep inside the box wall. Conduit openings shall terminate not less than five inches (5") above the bottom of all boxes and a minimum of six inches (6") below the top of the Type I and Type IA boxes and twelve inches (12") below the top of Type II and Type III boxes. Conduits entering through the junction box wall shall extend a minimum of two inches (2") to a maximum of three inches (3") inside the box wall, and be a minimum of six inches (6") above the bottom.

Conduit runs shall avoid drainage collection points where possible. At low points in all conduit runs, a one-half inch (1/2") drain hole shall be drilled in the bottom of the lower straight section of the sweep elbow and sump containing approximately two cubic feet of coarse concrete aggregate material shall be installed. Additional drains shall be placed adjacent to all junction boxes and structures, regardless of the method of conduit placement employed. Drilled holes in conduit shall be deburred inside and out to prevent scraping of conductors. The exterior of the one-half inch (1/2") hole shall be wrapped with approved filter cloth material and secured as directed or approved by the Engineer.

Conduits for future use shall be provided with grounding bushings, bonded to ground, and capped with an approved plastic insert type or expandable rubber plug. Tapered or universal fit plugs are not acceptable for final acceptance. A polypropylene pull rope with two hundred pound (200 lb) minimum tensile strength shall be installed in all conduits which are to receive future conductors. At least two feet (2') of pull rope shall be doubled back into the conduits at each end.

Contractor shall mark all underground conduits with a continuous strip of 4-mil-thickness, six inch (6") width polyethylene marker tape. Contractor shall mark the tape with a black legend on a red background and buried nine inches plus or minus three inches (9" ± 3") below the finished grade. Contractor shall place two strips of marker tape side-by-side under all road crossings.

Where new junction boxes are placed in existing rigid metal conduit runs, the conduit shall be fitted with threaded bushings and bonded.

Conduit leading to soffit, wall or other lights or fixtures below the grade of the junction box shall be sealed by means of an approved sealing fitting and sealing compound.

Existing underground conduit without conductors to be incorporated into a new system shall be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

The Contractor, at his expense, may use conduit of larger size than shown on the Drawings, and where used, it shall be for the entire length of the run from outlet to outlet. Reducing couplings are not permitted.

When extending existing conduits or installing junction boxes in existing conduit runs, extend the conduit into the proposed junction box or foundation using drains, elbows and bonding as required for new installations. When adjusting junction boxes, shorten or lengthen existing conduits to meet clearance requirements. Complete extensions and modifications to existing conduits using the same size and types of materials.

Contractor shall clean all debris and moisture out of conduits before installing conductors or cables.

All abandoned conduits shall be removed from junction boxes. Contractor shall remove all conductors prior to abandoning conduit.

All knockouts, in junction boxes and for new conduit or removed conduit shall be grouted.

For thaw wire systems, one inch (1") liquid tight flexible metal conduit (LFMC) shall be used in manholes and oil & grit separator facilities. LFMC shall conform to UL 360 and be third party certified for outdoor use in wet and oily locations, for direct burial in Portland Cement Concrete, and for sunlight exposure. Provide liquid tight fittings that are third party certified for use in wet and Class 1, Division 2 locations.

Article 7.2 Measurement

Measurement for furnishing and installing conduit is per linear foot of the size and type set forth in the Drawings and Bid Schedule. Measurement is the horizontal distance from center of device to center of device, or from station to station. Measurement shall include all fittings, couplings, pull wires, caps, vertical conduit risers, and elbows, and bonding and grounding conductors, which shall be considered incidental to conduit installation.

Conduits installed in manhole and catch basins shall not be measured, but rather the following distances shall be considered standard unless determined otherwise by the Engineer:

Manhole	forty feet (40')
Catch Basin	sixteen feet (16')

Article 7.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section. Payment for trench, backfill, and wire are separate bid items.

Payment shall be made under the following units:

ITEM	UNIT
GRC Steel Conduit (Size)	Foot
Schedule 40 PVC Conduit	Foot
Schedule 40 HDPE Conduit (Size)	Foot

SECTION 80.08 JUNCTION BOXES

Article 8.1 General

The Work under this Section consists of performing all operations pertaining to removing and adjusting existing junction boxes to grade and for furnishing and installing a new junction box of the type specified. This Work shall include all excavation, bedding material, and bonding and grounding hardware.

Type I junction boxes shall not be used.

Junction boxes shall be installed at the approximate locations shown on the Drawings. The Contractor, at his expense, may install additional junction boxes to facilitate his Work. Junction boxes shall be located so they are not in the roadway, sidewalk, driveway, or pathway surfaces, unless otherwise noted in the Drawings. Where practical, junction boxes shown in the vicinity of curbs shall be placed a minimum of two feet (2') from the back of curb. Junction boxes shall not be located in areas where drainage collects or flows, including side slopes.

Article 8.2 Materials

Contractor shall provide precast reinforced concrete boxes (junction boxes) with cast iron lids, of the sizes and details shown on the Drawings.

Contractor shall provide precast reinforced concrete additions (junction box extensions) of the sizes and details shown on the Drawings with dimensions confirmed by field measurements.

Illumination junction boxes shall be pre-cast reinforced concrete with cast iron lids of the sizes and details shown on the Drawings.

All Portland concrete cement utilized in the adjustment of the Junction Box shall conform to the requirements as specified in Division 55, Section 55.05 - Manholes and Catch Basin Manholes. The joint sealing compound utilized to seal the joint between the electrical vault's lid and walls shall be Ram-Nek Flexible Plastic Gasket or an approved equal.

All hardware installed inside junction boxes shall be stainless steel.

Article 8.3 Construction

All junction boxes with metal covers shall have the covers effectively grounded with a four foot (4') tinned copper braid for Type I and Type IA Junction Boxes or a six foot (6') tinned copper braid for Type II and Type III Junction Boxes. Use only stainless steel bolt assembly components to attach bonding braid to the cover (lid). Bond junction box lids to the grounding conductor using copper braid with a cross sectional area equal to an 8 AWG conductor and eyelets spaced at six inch (6") intervals.

The entire bottom of all junction boxes shall be bedded in coarse concrete aggregate material of a minimum depth of eighteen inches (18").

Top of junction boxes shall be recessed not to exceed one-quarter inch (1/4") below the sidewalk grade or top of adjacent curb. When located in an unpaved section adjacent to a paved shoulder the junction box shall be located one inch (1") below the finished grade and shall be installed one-quarter inch (1/4") below the surface in paved areas.

Junction boxes located in areas requiring grading shall be adjusted as directed by the Engineer. Junction boxes located in seeded areas shall be adjusted to two inches (2") below the surface.

Junction boxes shall be located immediately adjacent to the pole or fixture they serve and at additional intervals to reduce the distance between junction boxes to:

1. 400 feet maximum for 25 pair interconnect cable.
2. 200 feet maximum for any other conduit runs.
3. If the limitations require additional junction boxes they shall be located on equal spacings subject to the above limitations.

Emboss the word LIGHTING on the lids of all junction boxes containing only lighting or thaw wire conductors, or only lighting and signal controller power conductors. Emboss the word TRAFFIC on the lid of all other junction boxes.

No later than forty-eight (48) hours prior to commencement of Work on adjustment of the Junction Box, Contractor shall contact the Traffic Signal Maintenance Shop.

Prior to removal of the Junction Box associated with traffic detector loops, Contractor, Engineer, and a Traffic Signal Maintenance Shop representative shall inspect and verify the condition of the Junction Box.

Prior to replacement of the Junction Box, Contractor, Engineer, and a Traffic Signal Maintenance Shop representative shall inspect the vault lid and vault structure to verify adjustments. Any Work, personnel, and/or materials required to properly correct problems shall be at Contractor's expense.

Article 8.4 Measurement

The method of measurement is the actual number of junction boxes removed, adjusted to grade and accepted, and the actual number of new junction boxes of the specified types furnished, installed, and accepted.

The unit cost for adjusting the Junction Box to finish grade shall include all labor, materials, and equipment. This shall include all required usable and unusable excavation, classified fill and backfill material, compaction, concrete cutting and removal, and required personnel. If the adjustment of the Junction Box necessitates pulling new cable to meet the specifications, all Work associated with pulling new cable, including the cost of the new cable and the work to pull the cable up into the required termination point, is considered incidental to the bid item "Adjust Junction Box to Grade".

All survey and staking work required to locate the junction boxes shall be incidental to the work.

Article 8.5 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Junction Box (Type)	Each
Adjust Junction Box to Grade	Each
Remove Junction Box	Each
Junction Box Extension (Type)	Each

SECTION 80.09 EXPANSION FITTINGS

Article 9.1 General

Expansion fittings, as detailed on the structure Drawings, shall be installed where the conduit crosses an expansion joint in the structure. Each expansion fitting shall be provided with a bonding jumper of stranded, No. 6 AWG, copper wire.

Expansion-deflection fittings shall be waterproof and permit a three-quarter inch (3/4") expansion and contraction and a three-quarter inch (3/4") deflection without deformation.

Article 9.2 Measurement

Expansion fittings shall be considered as incidental to other Work.

Article 9.3 Basis of Payment

No separate payment for these items is allowed.

SECTION 80.10 CONDUCTORS

Article 10.1 General

Conductor sizes shall be based on the American Wire Gauge (AWG). Sizes shall conform to the Drawings or, when not shown, to the Conductor Termination Table below. Conductors shall be seven-conductor No. 14 AWG (7C-#14 AWG) for all vehicle heads, and five-conductor No. 14 AWG (5C-#14 AWG) for all pedestrian heads.

Conductor Termination Table

CONDUCTORS/ CABLE	CIRCUIT	WIRE COLOR	AWG NO.	BAND LEGEND
7	Vehicle Red Arrow	Red	14	Head Number
	Vehicle Yellow Arrow	Orange		
	Vehicle Green Arrow	Green		
	Common Neutral	White		
	Spare	White/Black		
	Spare	Black		
	Spare	Blue		
7	Vehicle Red Arrow	Red	14	Head Number(s)
	Vehicle Yellow Arrow	Orange		
	Vehicle Flashing Yellow Arrow	Black		
	Vehicle Green Arrow	Green		
	Common Neutral	White		
	Spare	White/Black		
	Spare	Blue		
7	Vehicle Red	Red	14	Head Number(s)
	Vehicle Yellow	Orange		
	Vehicle Green	Green		
	Common Neutral	White		
	Spare	White/Black		
	Vehicle Yellow Arrow	Black		
	Vehicle Green Arrow	Blue		
5	Pedestrian Don't Walk	Red	14	Head Number
	Pedestrian Walk	Green		
	Common Neutral	White		
	Spare	Orange		
	Spare	Black		
5	Photo Elec. Control	Black	14	PEC
	PEC Load to Contactor	Red		
	Neutral	White		
	Spare	Orange		
	Spare	Green		
3	Pedestrian Pushbutton	Black	14	Head Number Located Under
	Neutral	White		
	Spare	Red		

Conductor Termination Table

CONDUCTORS/ CABLE	CIRCUIT	WIRE COLOR	AWG NO.	BAND LEGEND
3	Flashing Beacon Ckt 1	Black	14	Head Number
	Flashing Beacon Ckt 2	Red		
	Neutral	White		
3	Preemption Confirmation Light	Black	14	"PRE" Conf Lt
	Neutral	White		
	Spare	Red		
3	Luminaire	Black	8	Circuit Number Circuit Number
	Luminaire	Red		
	Luminaire	White		
3	Service to Controller	Black	6	"SIG" No Band No Band
	Neutral	White		
	Spare	Red		
3	Sign Luminaire	Black	8	SIGN SIGN
	Sign Luminaire	Red		
	Sign Spare	White		

All insulated conductors shall consist of uncoated, stranded copper conforming to the specifications of ASTM B8, except for detector loop lead-in which shall consist of stranded, tinned copper.

Grounding conductors shall be bare copper of the gauge required by the Code and may be stranded, solid or braided.

Conductors used for the following purposes shall conform to the referenced specifications.

Article 10.2 Control Cables

Vehicular signal faces, pedestrian signal faces, pedestrian pushbutton detectors, flashing beacons, preemption confirmation light, and photo electric controls shall be wired with signal cable conforming to IMSA 20-1.

Article 10.3 Power Conductors and Cables

Power conductors and cable shall conform to ICEA Publication No. S-66-524, NEMA Publication No. WC7, and U.L. Standards. Conductors shall be insulated with chemically cross-linked polyethylene conforming to U.L. type XHHW or XHHW-2. Insulation shall be rated for 600 volt operation.

Three conductor cables shall have black, white, and red colored conductors.

All single-wire conductors and cables shall have clear, distinctive and permanent markings on the outer surface throughout the entire length giving the manufacturer's name or trademark, the insulation type-letter designation, the conductor size, voltage rating and the number of conductors if a cable.

Roadway and sign illumination cable shall consist of insulated conductors with a low density, high molecular weight polyethylene jacket.

Power cables with conductors No. 6 AWG and larger shall be PVC or neoprene jacketed.

Load center control circuit wiring shall be No. 12 AWG XHHW.

Conductors in controller cabinets that carry the full signal load circuit shall be No. 10 AWG or larger.

All cabinets shall be wired with conductors sized to handle the amperage drawn under full cabinet use.

Illumination tap conductors that run from the fused disconnect kit in the pole base to the luminaire shall be No. 10 AWG.

Temporary overhead illumination conductors shall be Triplex #6 Aluminum with black cross-linked polyethylene insulation.

Article 10.4 Detector Cables

A. Loops and Lead-in Detector Cables

Conductors for detector inductive loops shall be UL listed as Tube loop detector wire No. 14 AWG stranded single conductor in PVC tube (IMSA specification 51-5).

Loop Lead-in Cables. Use a tray cable that conforms to the following specifications to connect the loop detectors to the terminal blocks in the controller cabinet. Furnish this cable, also known as Snyder Cable, manufactured according to UL Standard 1277. Third-party certify these cables as Type TC and certified for use in underground conduit or as an aerial cable supported by a messenger, rated for 600 volts AC operation and sunlight resistance.

Use No. 18 AWG, sixteen (16) strand, tinned copper conductors per ASTM B-33 insulated with wet rated cross-linked polyethylene. Twist the conductors into seven (7) pairs colored to match the following: Black & Red, Black & White, Black & Green, Black & Brown, Black & Yellow, Black & Orange and Black & Blue.

Provide each twisted pair with an overall aluminum foil coated Mylar shield that provides one hundred percent (100%) coverage and a 20 AWG tinned copper drain that is in constant contact with the foil side of the shield. Apply a tight fitting PVC jacket over the conductor assembly.

B. Optical and GPS Radio Detector – Preemption Cable

The three-conductor No. 20 AWG (3C-#20 AWG) cable shown on the Drawings shall be used in the Optical Detectors – Preemption System. The cable shall be sheathed in a black PVC jacket and include three (3) No. 20 AWG insulated conductors, and one (1) No. 20 AWG drain wire enclosed within an aluminized polyester shield. All conductors shall be stranded, individually tinned copper. The cable shall contain one yellow, one blue, and one orange insulated conductor. The cable shall be rated for 600 volts operation and be suitable for direct bury, installation in a conduit, and direct exposure to the atmosphere. Cable shall be a GTT Company's No. 138 Opticom cable, or approved equal.

GPS Radio detection cable shall be Opticom Model 1070 GPS Installation cable.

C. Radar Detector Cable

Cable for each radar unit shall be a Matrix Type 2 Home Run cable (MTX2 HMRN).

Article 10.5 Telemetry Cable

Interconnect cable shall consist of solid copper No. 19 AWG conductors of the number of pairs called for in the Drawings meeting the requirements of REA specification PE-39 for filled telephone cables. The shield may be either copper or aluminum.

Telemetry interconnect cable shall contain the number of pairs as shown on the Drawings. The conductors shall be covered with a .005-inch copper or aluminum shield that is electrically intact throughout the entire length of the new circuit. Grounding continuity of all copper shields shall be maintained at all termination points. T-Splices shall be made at the terminal block in the controller cabinet. Configuration and color coding shall be in accordance with the Interconnect Termination Table.

INTERCONNECT TERMINATION TABLE

Telemetry Cable: Type PE-39, No. 19 AWG, Solid Copper

Pair #	Tip	Ring	Pair #	Tip	Ring
1	White	Blue	14	Black	Brown
2	White	Orange	15	Black	Slate
3	White	Green	16	Yellow	Blue
4	White	Brown	17	Yellow	Orange
5	White	Slate	18	Yellow	Green
6	Red	Blue	19	Yellow	Brown
7	Red	Orange	20	Yellow	Slate
8	Red	Green	21	Violet	Blue
9	Red	Brown	22	Violet	Orange
10	Red	Slate	23	Violet	Green
11	Black	Blue	24	Violet	Brown
12	Black	Orange	25	Violet	Slate
13	Black	Green			

Article 10.6 Measurement

In this Article, the word “structure” means a pole, junction box, load center, or controller cabinet, and the word “cable” also refers to single conductors, when individual conductors are in the bid schedule. Each cable the Contractor installs shall be measured in horizontal feet from the center of a structure to the center of the adjacent structure, or from station to station. All terminations, markings, slack and other incidental supplies required to meet the provision of the Specifications are not measured, and are considered incidental to the Contract.

Wire and cable within poles, cabinets, and other devices are included under those bid units.

All grounding conductors are incidental to other Work and shall not be measured for payment.

Article 10.7 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
(No. of Conductors) (Size of Conductors) (Type of Cable)	Foot

SECTION 80.11 WIRING

Article 11.1 General

Conductors in fixtures and cabinets shall not be spliced and shall be cabled together with self clinching nylon ties. All conductors, including spares shall be attached to terminal blocks with "spade" type terminal lugs.

Conductors shall not be pulled into conduit until junction boxes are set to grade, crushed rock sumps installed, grout placed around the conduit, and rigid metal conduits are bonded to ground.

Conductors shall be pulled by hand or by commercially built cable pulling equipment that is specially designed for that purpose. The cable pulling device shall be equipped with a force limiting circuit and force gauge. The cable-pulling device shall be approved by the Engineer before it is allowed to be used. Powdered soapstone, talc, or other inert lubricant shall be used in placing the cables and conductors in conduit.

When new conductors are to be added to a conduit with existing conductors, all conductors shall be removed and the conduit cleaned with a mandrel or brush. Then both old and new conductors shall be pulled through as a unit. In a new installation, all conductors shall be pulled through the conduit as a unit.

Contractor shall leave at least three feet (3') of slack, but not more than four feet (4'), for each conductor at each lighting and combination pole, and in each junction box, splice location, and controller base. Where lighting conductors are contained in a conduit within the pole, the slack is not required.

Contractor shall install a nylon pull rope in all conduits where cable is replaced and/or removed.

The neutral for pedestrian push button circuits shall be separate from the signal indication circuit neutral.

All control/signal conductors shall be run continuously without splices from a terminal block located in a cabinet, compartment, or signal head, to a similarly located terminal block.

Contractor shall splice illumination cable in pole bases and shall use approved fuse kits only. Contractor shall not use wire binding screws, studs or nuts.

With the prior approval of the Engineer, Contractor may use illumination cable splices in junction boxes. Contractor shall join the individual conductors by the use of non-insulated, overlap type pressure connectors insulated with mastic-lined shrink tubing. Contractor shall not use wire binding screws, studs or nuts. Contractor shall stagger splices to minimize overall diameter.

Illumination cable conductor splices shall be encapsulated in a rigid, two-piece, transparent, snap together, plastic mold specifically designed for each splice type. Molds shall have dimensions suitable for the splice, encase the cable outer protective jackets, be rated for 600 volts, and have fill and vent funnels for epoxy resin. Contractor shall fill the splice mold bodies, with epoxy resin, that are resistant to weather, aromatic and straight chain solvents, and does not sustain combustion.

Splices shall be insulated by: 1) a heat shrink tubing internally coated with an approved sealing compound or, 2) a cast of self-curing epoxy resin which is compatible with the wire insulation to form a weatherproof joint. Each insulated kit shall encompass only one cable and include the outer protective jacket(s).

Loop lead-in cable shall be run in a continuous manner without splices from the controller cabinet to the curbside detection junction box. Splicing of the loop conductors to the lead-in cable shall be in conformance with Section 80.18, Article 18.1 – Loop Detectors and Standard Detail 80-60.

Each loop lead-in cable pair shall then run without splices to the terminal block in the controller assembly, where all series or parallel connections shall be made. At a splice location, a short section of the cable jacket shall be removed and only the shielded pairs dedicated to the loops being spliced shall be cut.

All cables and single wire conductors shall be permanently identified using labels in all pole bases and cabinets, at each detector loop tail/lead in cable and illumination cable splices and in junction boxes.

Contractor shall furnish the two types of identification tags listed below that require a written legend, and write the legends specified neatly and legibly, using a black marking pen specified by the manufacturer. Contractor shall ensure that legends conform to Section 80.10, Conductor Termination Table, or as shown on the Drawings or detailed in the Special Provisions. Contractor shall replace, at no expense to the Owner, all identifications tags that the Engineer deems are illegible.

Use identification cable ties for labeling loop detector tails and for each set of paired loop lead-in conductors in the controller cabinet. Furnish identification cable ties made of nylon that have a nonmagnetic stainless steel locking device embedded in the head and a tag attached “flag style” to the head. The cable ties shall consist of a single strap with a minimum size tag of three-quarters inch by five-sixteenth inch (3/4” x 5/16”).

To label all other cables, use cable tags made of nylon reinforced vinyl that is impervious to the elements and shall not tear. Provide tags with a four inch by one and three-quarters inch (4” x 1 3/4”) minimum size that are attached flag style at one corner to a single strap. Furnish yellow tags for labeling all signal and interconnect cables and red tags for labeling lighting and feeder cables.

Contractor shall remove abandoned conductors/cables.

The control and power cables shall be terminated as shown in 80.10, Conductor Termination Table. Three conductor power cables shall always have a spare. The white or red conductor shall be left as a spare, when the circuit is either 480 volt or a neutral is required, respectively.

Terminate all spare conductors on terminal blocks.

Article 11.2 Measurement

Work performed under this article is considered incidental to other Work.

Removal and disposal of abandoned conductors is not measured for payment and is incidental to other Work. All splices, pull rope, cable tags, connectors, and fused disconnects are also considered incidental and no payment shall be made.

The Traffic Signal Maintenance personnel shall test and perform termination for all traffic loop detectors. The Contractor shall prepare the lead-in cables for termination, including labeling, insulation stripping and fitting with termination connectors.

When an existing active signal system is being modified, the Traffic Signal Maintenance personnel shall terminate all control cables within the traffic signal controller cabinet. It shall be the Contractor's responsibility to prepare the cables for termination.

The Traffic Signal Maintenance personnel shall splice, test and perform termination on all interconnect wiring operations.

The Traffic Signal Maintenance personnel shall install the connectors on the ends of PTZ/Network camera and radio interconnection cables.

Article 11.3 Basis of Payment

No separate payment is allowed for this item.

SECTION 80.12 FUSED SPLICE CONNECTORS

Article 12.1 General

A fused, quick disconnect, splice connector shall be installed between the line and luminaire down lead conductors in the base of every pole equipped with a luminaire.

Fused splice connectors shall be installed for all other electrical or communication equipment installed on the pole and shall connect, at the pole handhole, the line conductors coming up from the base to the conductors in the pole shaft.

The connector shall be weather tight and consist of two halves: a single unit line side socket and load side plug. The plug and socket assembly shall be designed so that the fuse remains in the load side plug without exposing live metal parts when the connector separates. Coil springs shall not be a part of the current carrying circuit.

For circuits with a neutral, the neutral conduct shall pass through the fused splice connector.

For shorter poles with smaller handholes, two (2) single conductor fused splice connectors shall be installed.

Contractor shall provide fuses for luminaires that are five (5) ampere, midget (13/32" x 1 1/2") ferrule type with a fast acting current limiting (KTK type) design or as specified by the Engineer. Fuse for other equipment shall be sized per the Drawings.

The Contractor shall install the fused connectors so they are readily accessible from the handhole. Tap conductors shall be installed so there is no slack when their ends touch the top of the foundation.

Ensure line side conductors enter the splice box body via the segment immediately adjacent lug to which they are terminated.

Article 12.2 Measurement

Work performed under this article is considered incidental to other Work.

Article 12.3 Basis of Payment

No separate payment is allowed for this item.

SECTION 80.13 BONDING AND GROUNDING

Article 13.1 General

Metallic cable sheaths, metal conduit, non-metallic conduit grounding wire, ballast and transformer cases, service equipment, sign switches, metal poles and pedestals shall be made mechanically and electrically secure to form a continuous system, and shall be grounded. Bonding and grounding jumpers shall be copper wire or copper braid of the same cross-sectional area as No. 8 AWG for all systems.

Bonding of slip-base type standards and pedestals shall be by means of two conductors from the conduit, one attached with a ground rod clamp to an anchor bolt and the other connected to the lower portion of the shaft. Bonding of standards with frangible coupling type bases shall be made by attaching one conductor from the conduit to the lower portion of the shaft. The attaching bolt shall be weather resistant and be a minimum of three-sixteenth inches (3/16") in size. The conductor for the shaft shall be forty-eight inches (48") long.

One side of the secondary circuit of step-down transformers shall be grounded.

Grounding of metal conduit, service equipment and neutral conductor at service point shall be accomplished as required by the Code and the serving utility, except that grounding electrode conductor shall be No. 6 AWG, or equal.

Unless otherwise sized on the Drawings, Contractor shall install a bare No. 8 AWG copper wire in all non-metallic and metallic type conduits for bonding purposes. When wire is pulled into or out of existing conduit and the conduit does not have an existing bare No. 8 AWG copper wire, Contractor shall install the ground wire.

Contractor shall splice grounding conductors with irreversible compression type connectors listed for the purpose.

Contractor shall install galvanized grounding bushings with insulated throats and stainless steel hardware on the ends of all metallic conduits. All non-metallic conduits, except for detector loop home runs, shall have a bushing installed. Contractor shall allow for bushings when installing conduits in foundations.

Contractor shall replace all missing or damaged conduit grounding bushings, conduit bonding jumpers and junction box lid braided bonding jumpers.

Contractor shall provide a minimum bare No. 8 ground connected to the tapped hole in the pole handhole.

Contractor shall provide a minimum No. 10 AWG green grounding insulated conductor in the pole shaft of all poles with luminaires, and shall terminate the conductor in the lighting fixture. Additional No. 10 AWG green grounding insulated conductors shall be installed for additional electrical or communication equipment installed on the pole.

Bond junction box lids to the grounding conductor using copper braid with a cross sectional area equal to an No. 8 AWG conductor and eyelets spaced at six inch (6") intervals.

An integral bare ground shall not be used in any cable.

Ground rods shall be three-quarter inch by ten foot (3/4" x 10') copper clad steel. Ground rod clamp and associated hardware shall be stainless steel.

Contractor shall ensure that the grounding conductor, between all ground rods, is continuous or spliced with irreversible ground rated splices.

Contractor shall install a three-quarter inch by ten foot (3/4" x 10') copper clad steel ground rod in the foundation space of a two-piece vault style traffic signal controller foundation. If two-piece vault style controller foundation isn't being installed, then install ground rod within Type 3 junction box adjacent to controller cabinet base.

Contractor shall use only stainless steel bolt assembly components to attach bonding braid to the cover (lid).

Furnishing and installing bonding and grounding conductors for electrical installations is incidental to this Contract and no additional payment is made.

Ground rods are not required to be installed in junction boxes unless otherwise noted on the Drawings.

Article 13.2 Measurement

Work performed under this article is considered incidental to other Work.

Article 13.3 Basis of Payment

No separate payment is allowed for this item.

SECTION 80.14 LOAD CENTERS

Article 14.1 General

When the positioning of the load center is not detailed on the Drawings, the location shown is approximate and the Contractor shall determine the exact location from the Engineer or the serving utility.

If a junction box is not shown on the Drawings adjacent to or within five feet (5') of any new or reconstructed load center, contact the Engineer immediately for clarification. A junction box of the appropriate size and type for the new system is required to be installed with the load center.

Where Contractor is required to install the service on a utility-owned pole, the positioning of the riser and service equipment is determined by the serving utility.

The serving utility shall approve load center meters, complete with manual circuit closing device and sealing rings. Contractor shall not mount meter sockets on doors.

All accessible sections containing non-metered conductors shall have sealing provisions that will accept Brooks Type 623 seal (0.047 stainless bail).

Contractor shall ensure that the load center is located ten to fifteen feet (10' to 15') from the power source, with a two inch (2") minimum conduit stubbed to within two feet (2') of the power source, and at a minimum depth of forty-two inches (42"). The conduit shall contain a pull-rope, and the end capped and marked with a two by six inch (2" x 6") board. Contractor shall coordinate exact location with the serving utility.

Contractor shall stub service conduit through base as shown on the Drawings.

Prior to the load center being energized by the serving utility, Contractor shall arrange to have it inspected and approved by the Engineer. Once the Engineer has provided approval, a Municipal Electrical Inspector shall provide the final authorization for energizing the load center. The certificate of electrical inspection, attached to the load center, indicates that the load center may be energized.

At all new and existing load centers, which require modification, the Contractor shall furnish conduit, conductors, contactors, breakers, transformers, and all necessary materials to complete the installation of the service, and upgrade to current code requirements.

Contractor shall label the load center as a unit by an Approved Independent Electrical Testing Laboratory (such as UL, ETL, CSA, etc.) defined by ANSI Standard Publication Z34.1 "Third Party Certification Programs for Products, Processes and Services" and conform to applicable published standards noted herein, the Drawings, and Special Provisions. Contractor shall label the load center as service entrance equipment. All Work shall conform to the latest edition of the National Electric Code as last amended and adopted by the Municipality of Anchorage.

All lighting load centers shall contain a multi-pole, 3-position control switch to provide selection of photocell operation. Contractor shall label switch positions "Auto," "Off" and "On." In the "Off" and "On" positions of the switch, Contractor shall ensure all leads to the photo control device are de-energized. Contractor shall install the switch inside the load center, accessible only through one of the lockable doors.

Contractor shall provide UL-approved and listed circuit breakers. Contractor shall provide an enclosed operating mechanism that is:

1. trip-free from operating handle on overload
2. trip-indicating
3. plainly marked with trip and frame size.

Multiple-pole circuit breakers shall have a common trip. Contractor shall ensure that all circuit breakers are quick-make, quick-break on either automatic or manual operation, and shall meet the requirements of the serving utility. Contractor shall ensure that the contacts are silver alloy enclosed in an arc-quenching chamber. An ambient temperature range of from -40° to +160° Fahrenheit shall not influence overload tripping of breakers.

Contractor shall connect ground bus of load center to ground rod(s) with #6 soft drawn bare copper and approved connectors.

Dimensions given are typical. Slight variations are allowable, subject to Engineer's approval.

Contractor shall submit four (4) copies of manufacturer's shop drawings for Engineer approval.

Contractor shall indicate the interrupting rating on panel schedules for each location.

On panel schedules for each location, Contractor shall indicate service rating of 120/240V, 3 wire; 240/480V, 3 wire; 100 AMP or 200 AMP.

Contractor shall provide a typed circuit directory for each load panel inside of the load center door, protected with a laminated plastic cover, describing each circuit, with even and odd numbered circuit breaker positions shown on separate parts of the directory. Contractor shall provide a power and control 1-line diagram protected by a laminated plastic cover inside the load center. Contractor shall include the following information on the directory and one-line diagram: Load Center Identification (A, B, etc.), Project Name, Municipal Project Number and Service Voltage.

Contractor shall ensure that the wiring configuration conforms to the appropriate electrical diagram, and as the panel schedule indicates for each intersection. Contractor shall complete a load center summary per appropriate detail drawing for each load center location.

Contractor shall ensure that all terminals are suitable for AL/CU termination, sized in accordance with ampere ratings.

Contractor shall provide #12 AWG XHHW as the load center control wiring.

Contractor shall ensure that the utility section is isolated from main load section and the distribution load sections by non-removable metal barriers, and equipped with landing lugs for utility termination.

The meter section shall contain a meter safety socket with safety shield and provisions for manual bypass of the meter. Contractor shall provide a link or lever type bypass with no external screws, bolts, or nuts. Horn and sliding types are not acceptable.

External screws, bolts, and nuts are not acceptable.

Contractor shall provide exterior ScotchCAL 220 labels with ownership and purpose, safety labels, interior identification labels, wiring diagram, and installation instructions with the load center enclosures.

Contractor shall label in a prominent manner all switches and circuit breakers for circuit and direction.

Contractor shall install load centers having 30 milliamp (ma) ground fault circuit breakers with ratings for all heat trace circuits as indicated on the Drawings.

Contractor shall label each load center with durable, weather resistant identification tags inscribed with: Maximum Fault Current _____A, Calculated ___/___/___.

Load Centers shall be equipped with a hasp for padlocks.

Circuit breakers shall be manufactured to fit the existing load center panel, industrial grade, and rated for the maximum available fault current indicated on the Plans.

Install short circuit fault current and arc flash placard on the existing load center. Placard shall reflect the calculation results shown on the Plans.

Article 14.2 Illumination Control

Contractor shall install photoelectric controls capable of switching multiple lighting systems directly. The photoelectric control shall consist of a photoelectric unit that shall cause a contactor to be energized, thus controlling the lighting circuit.

Photocell Installation:

Contractor shall install photoelectric units on the load center, unless the Engineer requires pole mounting of the photoelectric unit because a load center mounted unit will not work properly due to ambient light sources. If required, Contractor shall provide photoelectric units for pole top mounting with a slip fitter, terminal block and with cable supports or clamps to support pole wires. Load center mounted photoelectric units shall be installed using ¾" GRC and mounted a minimum of 18" above the load center. There shall be no separate payment for providing the required photoelectric units.

Contactors:

The contactors shall have contacts rated to switch thirty (30) or sixty (60) AMP inductive loads as the Drawings specify, and are normally open. Contractor shall provide mechanical armature type contactors consisting of an operating coil, a laminated core, a laminated armature, contacts, and terminals with contacts made of fine silver, silver alloy, or superior alternative materials and rated for 480V.

Contractor shall provide the lighting contactor coil(s) rated for operation at 240 VAC.

Photoelectric Unit:

1. The photoelectric unit shall consist of a light sensitive element connected directly to a normally closed, single pole throw control relay without intermediate amplifications.

2. The unit is either the horizontal sensing or zenith sensing type and shall conform to the following:
 - a. The supply voltage rated is 60 hertz (Hz), 105-277 volts.
 - b. The maximum rated load is a minimum of 1,800 volt-amperes.
 - c. The operating temperature range is from -40°F. to +150°F.
 - d. The power consumption is less than 10 watts.
 - e. The base of the unit has a 3-prong, standard, twist-lock plug mounting.
3. Units for highway lighting shall have a "turn-on" between one (1) and five (5) foot candles and a "turn-off" at between one and one-half and five (1½ and 5) times "turn-on."
4. Contractor shall ensure measurements conform to the procedures set forth in EEI-NEMA Standards for Physical and Electrical Interchangeability of Light-Sensitive Control Devices Used in the Control of Roadway Lighting.
5. The photoelectric control unit shall plug into a phenolic resin twist lock receptacle, adjusted to north sky set in a cast aluminum-mounting bracket with a threaded base. When installed on the load center, Contractor shall ensure the bracket is coupled to the end of a rigid metal conduit. When installed on the top of steel poles, Contractor shall ensure the bracket is installed in the center of the rain cap, secured with a locknut and made watertight with a fillet of silicone caulking compound. When installed inside the load center, Contractor shall ensure the installation conforms to the manufacturer's recommendations and that all load center penetrations/openings are silicon sealed.
6. Contractor shall screen photoelectric units to prevent artificial light from causing cycling.

Control Selector Switch:

Load centers with illumination control shall contain a three position, maintained selector switch. The left position shall be "On". The center position shall be "Off". The right position shall be "Auto". In the on and off position the Contractor shall ensure the switch interrupts all leads to the photocell.

The selector switch shall have three contacts closed in the auto position and one contact closed in the on position.

There shall be an intermediate terminal between the selector switch and the photocell leads. The photocell leads shall not be terminated directly on the switch contacts. The intermediate terminal shall be accessible to maintenance personal without disconnecting or removing other equipment installed in the load center.

Article 14.3 Step Up/Step Down Transformer

Step up/step down transformers in 480 volt circuits shall be 240-120 volt, 60 Hz type with volt-ampere ratings as shown on the Drawings. Transformers shall carry rated volt-amperes continuously without exceeding 85°C temperature rise above 25°C ambient.

Where installed outside of the load center, use a non-ventilated transformer fabricated of aluminum, stainless steel or galvanized steel. Coat enclosures fabricated of sheet metal with moisture resistant paint.

The case shall be fabricated of aluminum, brass, or galvanized steel. The case shall be coated with moisture resistant paint.

The unit shall be filled with a high melting point insulating compound and shall be hermetically sealed to ensure satisfactory operation under continuous submersion in water.

Transformer leads shall be insulated with non-hygroscopic material and shall extend at least nine inches (9") outside the case seal.

The primary and secondary sides of the transformer shall be "protected" in the load center.

Article 14.4 Load Center Enclosure

All doors shall be equipped with continuous stainless steel pin hinges, coin latches, and hasp for padlock.

Meter section door shall have a clear lexan meter reading window, 0.187" minimum thickness, with a minimum size of eight by eight inches (8.0" x 8.0"), and shall include a silicon seal to door.

The load center shall be provided with internal mounting facilities for a one-half inch (1/2") anchor bolt installation as well as for use with a standard factory mounting base assembly.

Construction shall be of zinc-coated A60 finish steel with minimum thickness as follows:

- Exterior Shell - 12 GA.
- Interior Doors - 14 GA.
- Interior Panels - 14 GA.
- Interior Covers - 16 GA.

The load center shall be painted with a two-part urethane paint undercoating inside and out. The final finish shall be a two-part urethane paint, standard white for removable panels and non-gloss silver-gray, Benjamin Moore GN-42, for the enclosure.

The required location for the hand-off-auto switch and the contactor is in the distribution load section.

All non-current carrying parts shall be bonded to ground.

Article 14.5 Post-Mounted Load Center, Type 2 - Underground Service

A post-mounted load center, Type 2, shall be defined in the Construction Drawings by reference to appropriate Standard Details for the load center, wiring diagram, and panel schedule.

Article 14.6 Post-Mounted Load Center, Type 3 - Overhead Service

A post-mounted load center with overhead service, Type 3, shall be defined in the Construction Drawings by reference to appropriate Standard Details for the load center, wiring diagram, and panel schedule.

Article 14.7 Single-Meter Pad-Mount Load Center, Type 1 & 1A

A single-meter pad-mount load center, Type 1A, shall be similar to Circle AW CMP-4111MN mounted on MB-1514 base or equivalent approved by the Municipal Traffic Engineer. It shall be defined in the Construction Drawings by reference to appropriate Standard Details for the load center, wiring diagram, and panel schedule.

A single-meter pad-mount load center, Type 1, shall be similar to Circle AW CMP-4900 series mounted on MB-2820 base or equivalent approved by the Municipal Traffic Engineer. It shall be defined in the Construction Drawings by reference to appropriate Standard Details for the load center, wiring diagram, and panel schedule.

Article 14.8 Measurement

Load centers shall be measured as units, complete and in place. Bases for load center enclosures shall be a separate bid item under "foundations."

Photoelectric units mounted on the load center shall not be measured separately for payment. The Work performed under Article 14.2 – Illumination Control, is considered incidental to Work performed under Articles 14.5 through 14.7, unless a pole mounted photoelectric unit is required.

Load center modifications shall be measured as units, complete and in place. This work includes furnishing and installing new circuit breakers in the existing load center, all work to terminate new cables on new circuit breakers, and installing short circuit and arc flash placards on the load center.

Article 14.9 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Owner shall pay fifty percent (50%) of the Contract unit price for each load center installed once each load center is green tagged by Building Safety. The remaining fifty percent (50%) of the Contract unit price for each load center shall be paid after the Contractor submits an approved final inspection from Building Safety.

Separate payment shall be allowed for pad-mount bases.

Payment shall be made under the following units:

ITEM	UNIT
Post-Mounted Load Center Overhead Service, Type 3	Each
Post-Mounted Load Center Underground Service, Type 2	Each
Single-Meter Load Center Enclosure, Type 1	Each
Single-Meter Load Center Enclosure, Type 1A	Each

Pole-Mounted Photocell Installation, Complete	Each
120/240 - 240/480, Transformer	Each
Load Center Modifications	Each

SECTION 80.15 WOOD POLES

Article 15.1 General

Wood poles for service or temporary installations shall be of the class shown on the Drawings. Wood poles used in temporary installations shall meet or exceed ANSI class 4 for poles used for temporary illumination only, and ANSI class 3 for poles used for temporary signalization.

Poles shall not have more than 180 degrees twist in grain over the full length. Sweep shall be no more than four inches (4"). Poles shall be placed in the ground to a depth of at least six feet (6'). The lengths of poles shall be twenty-five feet (25') for service poles and thirty-five (35') feet for other poles, unless otherwise specified.

After each wood pole is set in the ground, the space around the pole shall be backfilled with selected earth or sand, free of rocks four inches (4") or larger, or deleterious material, placed in layers approximately four inches (4") thick and thoroughly compacted with mechanical tampers.

Mast arms and tie rods for wood pole installations shall conform to the provisions of Section 80.05 – Poles, Steel Pedestals, and Posts, and to the details shown on the Drawings. Each mast arm shall be provided with an insulated wire inlet and wood pole mounting bracket for mast arm and tie rod cross arm.

Overhead equipment shall provide a minimum vertical clearance of eighteen feet (18') from bottom of equipment to the pavement.

Wood poles, not to be painted, shall be pressure treated after fabrication with creosote, pentachlorophenol (oil borne), or copper naphthenate (oil borne) in accordance with the latest applicable standards of the American Wood Preservers Association. Where it is impractical to obtain the specified retentions because of the character of the wood in the charge, the treatment shall be to refusal. The retentions may be determined either by gauge or scale readings or by assay. Treated poles shall be coated in conformance with current EPA regulations.

Wood poles shall not be used for permanent installations.

Article 15.2 Measurement

Wood poles used for temporary support of signals, signs and illumination shall be measured as temporary wood pole structures installed and removed.

Article 15.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Temporary Wood Pole Structures	Each

SECTION 80.16 MISCELLANEOUS

Article 16.1 Sign Switches

Each sign illumination installation shall be provided with a disconnect switch mounted on the sign standard or structure, as shown on the Drawings. Where the sign lighting is served from a multiple service, each sign structure shall have a 120-volt, 240-volt, or 480-volt circuit breaker, approved by UL as service equipment, and rated as shown on the Drawings.

Enclosures for the sign breaker shall be galvanized or baked enamel NEMA Type 3R, and shall be provided with top hinged cover, hasp for sealing cover and provisions for locking.

Article 16.2 Field Tests

Prior to acceptance of the Work, the Contractor shall perform the following tests on all traffic signal, sign illumination, and lighting circuits, in the presence of the Engineer.

A. Tests

Any fault in any material or in any part of the installation revealed by these tests shall be replaced or repaired by the Contractor at his expense in an approved manner, and the same test shall be repeated until no fault appears.

1. Continuity

Each circuit shall be tested for continuity.

2. Grounds

The test for grounds in each circuit shall consist of the physical examination of the installation to ensure that all required grounding bushings, bonding jumpers, and ground rods have been installed and are mechanically firm.

3. Insulation

A megohm test shall be made on each circuit, between circuits and between the circuit and a ground. The insulation resistance shall not be less than 100 megohms or the minimum specified by the manufacturer, measured at 500 volts direct current (VDC). All lamps and magnetometer sensing probes shall be disconnected prior to performing the megger test.

4. Circuit

Every signal indication circuit shall be energized with lamps installed prior to installation of the load switches.

5. Functional

The following tests shall be performed on each signal and lighting system after all of the component circuits have satisfactorily passed the tests for continuity, grounding, insulation integrity and circuitry.

B. Functional Testing

During the test periods, the Contractor shall maintain the system or systems. The cost of any maintenance necessary shall be at the Contractor's expense.

1. The functional test for each new or modified traffic signal system shall consist of not less than twenty-four (24) hours nor more than five (5) days of continuous flashing operation, followed by not less than five (5) days of continuous satisfactory operation. The Municipal Traffic Engineer may decide to omit the flashing portion of the test for modified signals systems and for new signals that replaced existing signals that remained in operation during the construction phase.
2. During the functional tests, signals shall not be switched from flashing operation to normal, continuous operation on a Saturday, Sunday, Monday, a Holiday, or the day after a Holiday.
3. The functional test for each lighting system and sign illumination system shall consist of an operational test for five (5) consecutive nights according to the regular lighting schedule.
4. The functional test for each flashing beacon system shall consist of not less than five (5) days of continuous, satisfactory operation.
5. A continuous five (5) day burning test shall be made on each pedestrian overcrossing and undercrossing lighting system before final acceptance.

The initial turn-on shall be made between 9:00 a.m. and 2:00 p.m. unless specified otherwise in the Special Provisions. Prior to turn-on, all equipment shown on the Drawings shall be installed and operable. This includes, but is not limited to, pedestrian signals and push buttons, signal face backplates and visors, vehicle detectors, intersection lighting and all regulatory, warning and guide signs. All signal faces shall be aimed as required by Sections 80.19 – Signal Heads and 80.20 – Pedestrian Signals.

Article 16.3 Galvanizing

A. General

Standards, pedestals, posts and cabinets of ferrous materials shall be galvanized in accordance with the provisions of ASTM A123 except that cabinets and cut out boxes may be constructed of material galvanized prior to fabrication.

Iron or steel pipe standards and mast arms shall be hot-dip galvanized after fabrication in conformance with the ASTM A123.

Tie-rods, nuts, washers, clamps, anchor bolts and other miscellaneous ferrous parts shall be hot-dip galvanized after fabrication in accordance with the provisions of ASTM A153. Anchor bolts shall be fully galvanized.

After galvanizing, the bolt threads shall accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

Rigid metal conduit shall be hot dip galvanized in accordance with American National Standards Institute specification ANSI C-80.1.

Galvanized coatings that have been cut or damaged shall be repaired in conformance with ASTM A780.

Lighting and signal structures shall be hot-dip galvanized to meet AASHTO M 111 and these specifications. Galvanizing kettles shall be large enough to completely submerge each element, the mast arm, and the pole. Submerge the complete/whole element in the galvanizing process. An element galvanized in sections shall not be accepted. After the poles and mast arms are galvanized, remove all excess zinc from all drip lines and points and the surfaces of all tube ends that form slip type joints to provide a smooth finish.

B. Cold Galvanizing

Repair hot-dip galvanized finishes that have been cut or damaged and cold galvanize the tops of pipe pile foundations with a premixed, single component, zinc rich paint that:

1. Meets the requirements of Federal Specification DOD-P-21035A, Galvanizing Repair Specification and ASTM A 780, Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings,
2. Contains ninety-five percent (95%) zinc, by weight, in the dried film, and
3. Is recognized under Underwriters Laboratories, Inc. component program as an equivalent to commercial hot-dip galvanizing.

Apply the paint directly to surfaces devoid of grease, oil, mill scale, rust, and paint. Clean soiled surfaces according to the following Steel Structures Painting Council (SSPC) specifications before applying the paint:

Solvent clean greases and oils according to SSPC-SP1

Power tool clean rust and easy to remove paint according to SSPC-SP3

Sandblast mill scale and firmly adhered paint according to SSPC-SP6 (commercial).

Apply the paint whenever the temperature of the pipe pile is at least five degrees Fahrenheit (5°F) above the dew point to avoid possible condensation and the relative humidity is less than eighty-five percent (85%). Apply two (2) coats of three (3) mil wet film thickness, applying the second coat at least twelve (12) hours after applying the first coat. (Each gallon will cover about four hundred and fifty (450) square feet of three (3) mil wet film thickness.)

Article 16.4 Painting for Structures

- A. General Requirements. Ship paint in strong, substantial containers, plainly marked with the name, weight, and volume of the paint content, together with the color formula, batch number, and the name and address of the manufacturer.

Reduction and clean-up thinners shall be as approved by the coating manufacturer. Ship all thinners in the manufacturer's original containers.

- B. The paint shall conform to the requirements outlined below:

1. Prime Coat. A generic single component, moisture cure, polyurethane (SC-MC-U) containing not less than 78% by weight zinc powder. Volume of solids shall be 60% minimum. Pigment type shall be zinc dust. Zinc in dry film shall

be 83% minimum, by weight. Weight per liter shall be 2750 g, minimum. Volatile organic compounds (VOC's) shall not exceed 450 g/L.

2. Intermediate Coat. A SC-MC-U containing not less than 480 g/L micaceous iron oxide (MIO). Volume of solids shall be 60% minimum. Pigment color shall contrast between the intermediate and prime coat and the intermediate and top coat. Weight per liter shall be 1550 g minimum. VOC's shall not exceed 450 g/L.
3. Top Coat. A single component, moisture cure, aliphatic polyurethane (SC-MC-ALIP-U), containing not less than 480 g/l micaceous iron oxide (MIO). Volume of solids shall be 60% minimum. Pigment color of the top coat shall be FSS FED-STD-595B, color number 26492. The color match shall be evaluated as a general match under a daylight source using ASTM D 1729. Weight per liter shall be 1550 g minimum. VOC's shall be less than 450 g/L.
3. All coatings shall pass the following tests:
 - a. Corrosion Resistance, ASTM B 117, Salt Spray Test. Minimum of 4000 hours with less than 2 mm creep from scribe. Panels shall be 3 mm minimum thickness cold rolled steel, having SSPC Near White Blast with 25 to 50 μ m angular profile.
 - b. Accelerated Weathering, ASTM G 53. Minimum 400 hours QUV B bulb with no chalking, cracking, or gloss loss greater than 20%.
 - c. Forward Impact, ASTM D 2794. Minimum 17 Nm impact.
 - d. Abrasion Resistance, ASTM D 4060. Less than 90 mm loss on CS-17 wheel, 1000 g/load, 1000 cycles.
 - e. Moisture Resistance, ASTM D 4585. Minimum 1000 hours at 38o C with no change in appearance.
 - f. Flexibility, ASTM D 522, Cylindrical Mandrel Bend Test. Bend around 12.5 mm diameter mandrel with no cracking.
 - g. Adhesion, ASTM D 4541. Minimum 3.5 Mpa on a certified pull test.

C. New Equipment.

1. Factory finish signal housing, brackets, fittings, backplates, and visors, with a single coat of environmentally safe, ultraviolet-resistant, polyester powder coating that is applied electrostatically at 90kV and baked for 20 minutes at 400 degrees Fahrenheit per ASTM D-3359, ASTM D-3363, and ASTM D-522. Coating to be a Dull Black finish meeting Federal Standard 595b-37038.
2. After erection, all exterior surfaces shall be examined for damage, and such damaged surfaces shall be cleaned and spot coated with primer and finish coat.

D. Reused Equipment.

1. Existing non-galvanized, damaged equipment shall be painted in the field, including Owner-furnished equipment. The equipment shall be washed with a stiff bristle brush using a solution of water containing two tablespoons (2

- tbsp/gal) of heavy duty detergent powder per gallon. After rinsing, all surfaces shall be wire brushed to remove all poorly bonded paint, rust, scale, corrosion, grease or dirt. Any dust or residue remaining after wire brushing shall also be removed prior to priming.
2. Factory or shop cleaning methods for metals shall be acceptable if equal to the methods specified herein.
 3. Immediately after cleaning, all bare metal shall be coated with Pre-Treatment, Vinyl Wash Primer, followed by two (2) prime coats of Zinc Chromate Primer for Metal.
 4. Signal equipment, excluding standards, shall be given a spot finishing coat on newly primed areas, followed by one (1) finishing coat over the entire surface.
 5. Ungalvanized standards shall be given two (2) spot finish coats on newly-primed areas.
 6. All paint coats may be applied either by hand brushing or by approved spraying machines. The Work shall be done in a neat and workmanlike manner. The Engineer reserves the right to require the use of brushes for the application of paint, should the Work done by the paint spraying machine prove unsatisfactory or objectionable.

Galvanized equipment with rusted areas shall be repaired as provided for in Article 16.3 - Galvanizing.

Article 16.5 Measurement

The Work performed under this section is considered incidental to other Work.

Article 16.6 Basis of Payment

No separate payment is allowed for Work performed under this Section.

SECTION 80.17 CONTROLLER ASSEMBLIES

Article 17.1 General

Each solid-state, traffic controller assembly shall operate various traffic signal devices as shown on the Drawings, to provide right-of-way, clearance and other indications with duration and sequence as determined by preset programming.

Details of operation for the complete controller assembly shall be in accordance with the traffic phases, preferential phase sequence and concurrence, signal indications, signal indication sequence, detection requirements and other details shown on the Drawings or as specified herein.

All controller assemblies shall conform to NEMA Standard Publication TS 2-2003 V02.06 level 2, Traffic Controller Assemblies with NTCIP Requirements as defined in NTCIP1202. Traffic Controller Assemblies shall meet or exceed the Environmental Requirements of Section 2 of the NEMA TS2-2003 V02.06 document. The Original Equipment Manufacturer (OEM) and its manufacturing and testing facilities shall be ISO 9001:2000 certified for processes involving the Traffic Controller Assemblies.

The cabinet shall be 100% compliant with Section 1605 of the American Recovery and Reinvestment Act of 2009, requiring the use of American iron, steel and manufactured goods.

The cabinet assembly shall be completely manufactured in the United States of America.

LED indicators shall be used for all electronic devices covered under Article 80.17.

Controllers shall be compatible with the existing Anchorage traffic control system and contain necessary internal communication modems. Compatibility must be 100% at the cabinet level to include inputs, outputs, telemetry protocol, and block upload and download of RAM data.

Manufacturer schematic shall be submitted to the Municipal Traffic Engineer or designated representative prior to approval of all controller assemblies.

The existing traffic signal monitoring system is Centracs ATMS by Econolite

Features of the existing local controllers and controller modules must be functionally duplicated to meet or exceed the performance of the existing equipment.

The existing local controller cabinets at other intersections include the following equipment: Econolite Cobalt ATC Touch 2100

Article 17.2 Controller Unit

Actuated Controller Unit (CU).

Provide solid state, Type A2N Actuated Controller Units (CU) meeting the requirements of Section 3 of the NEMA Standard Publication TS 2-2003 V02.06, Traffic Controller Assemblies with NTCIP Requirements.

1. The CU must meet the referenced National Transportation Communications for ITS Protocol (NTCIP) and comply with publication TS 3.2 the Simple

Transportation Management Framework, and shall meet the requirements for Conformance Level 2

2. The software shall comply with NEMA TS 3.3, the Class B Profile, and shall include both an EIA/TIA 232-E and an FSK modem interface for NTCIP based communications.
3. The CU shall implement conformance groups and optional object groups as defined in NEMA TS 3.4 and TS 3.5 for A2N level 2.
4. Provide controllers with display heaters or enhancements to improve viewing in temperatures below 0 °F.
5. Provide controllers having an interface compatible with Trafficware Synchro traffic modeling software.

Furnish one (1) Econolite Cobalt ATC Touch 2100 controller unit with TS2 Type 2 connectors or approved equal also meeting the following requirements:

A. HARDWARE

1. Enclosure
 - a. Compact the controller to fit in limited cabinet space. It shall rest on a shelf that is not more than 7" deep. External dimensions shall be no larger than 10 1/4" x 15 1/4" x 9" (H x W x D).
 - b. Construct the enclosure of aluminum and finish with an attractive and durable protective coating. Permanently display model, serial number, and program information on the top surface.
2. Electronics
 - a. Modular electronics with vertical circuit boards. Horizontal circuit cards are not acceptable.
 - b. Use a microprocessor for timing and control functions. Verify continuing operation of the microprocessor by an independent monitor circuit that is set an output and indicate an error message if a pulse is not received from the microprocessor within a defined period.
 - c. In the interest of reliability, do not use sockets for any electronic device. Devices must be directly soldered to the printed circuit board. Use surface mount parts for the majority of the electronic components in the controller.
 - d. Use a built-in, high-efficiency switching power supply to generate required internal voltages as well as 24 VDC for external use. Regulate voltages and monitor with control signals. Mount the fuses on the front of the controller for 120 VAC input and 24 VDC output.
 - e. Derive timing of the controller from the 120 VAC power line.
 - f. Store user-programmed settings and intersection configuration data in Flash Memory. Memory requiring an energy storage device (battery or capacitor) to maintain user data is not acceptable. To facilitate the

transfer of user programmed data from one controller to another, a data transfer module (data key) using a separate serial flash memory device is an option. This data transfer module shall be easily removable and directly accessible from the front of the controller. The controller shall not require this module to be present for proper operation.

- g. Store controller software 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 is not acceptable. Option to update software on the controller using a Windows based computer. Allow updating the controller software via a serial or Ethernet port from the front of the controller. Updating the controller software shall require the intersection to be in flash for no more than ten seconds using Ethernet file transfer.
 - h. Printed circuit boards shall meet the requirements of the NEMA Standard plus the following requirements to enhance reliability:
 - (1) Plated -through holes and exposed circuit traces with solder.
 - (2) Solder mask material covering both sides of the printed circuit board.
 - (3) Clearly marked circuit reference designation for components and the polarity of capacitors and diodes adjacent to the component. Designated pin 1 for integrated circuit packages on both sides of printed circuit boards.
 - (4) Printed circuit board assemblies, except power supplies, coated with a clear moisture -proof and fungus -proof sealant.
3. Front Panel
- a. Front of the controller consisting of a panel for the display, keyboard, and connectors for necessary user connections. Maintenance of the electronic circuits and option installation will be possible by opening the front panel only.
 - b. Required 16-line by 40-character/line alphanumeric liquid crystal display (LCD) to show program, and status information with the display area nominal measurements of 2 1/2" x 4 1/2" (H x W), or larger. Provide, for ease of viewing, backlighting by light emitting diodes and multiple levels of contrast adjustment. Adjustable display contrast with front panel mounted push buttons. The use of user potentiometers for display contrast shall not be acceptable.
 - c. Clearly labeled front-panel operator inputs and environmentally sealed electrometric keys. Including a 10 digit numeric keypad, nine function keys, an oversized ENTER key, and an oversized four arrow cursor control key.
 - d. Required nine function keys, clearly labeled, and providing the following operation:
MAIN MENU - Pressing the Main Menu key displays the main menu.

SUBMENU - Pressing the Sub Menu key from a data screen displays the current submenu.

NEXT DATA - Pressing the Next Data key searches for the first non-zero data field, thus allowing rapid search for valid entries.

NEXT SCREEN - Pressing the Next Screen key I displays the next screen, thus allowing rapid advancement from screen to screen.

HELP - Pressing the Help key at a data entry field displays a help screen about that field.

STATUS DISPLAY - Pressing the Status Display key presents the intersection status display.

NEXT PAGE - Pressing the Next Page key advances to the previous or next group of data entry screens in a submenu.

BACKLIGHT - Pressing up and down arrow-shaped keys adjusts the backlighting of the LCD display screen for brighter or dimmer contrast.

SPECIAL FUNCTION - Pressing the special function key places Pedestrian Calls while viewing the main status display, lock access to controller data until supervisor or data change access codes are entered, and enter hexadecimal values.

CLEAR - Pressing the clear key aborts a data entry and restores the current value.

4. Data Key

- a. A data key available for use as a database storage device (backup) or as a database transfer module capable of storing a minimum 256KB of data.
- b. The data key hot swappable, to be inserted and removed without powering down the controller.
- c. The data key capable of storing the entire controller database and shall retain the information without use of battery or capacitor backup.
- d. The data key is not required by the controller to be present during normal operation.

5. Connectors

- a. Accessible interface connectors from the front of the controller. Controller models able to accommodate different versions, as follows:
 - (1) NEMA TS2 Type 1
 - (2) NEMA TS2 Type 2
 - (3) NEMA TS1
- b. Connectors and signals compatible with the Econolite Model ASC/2, ASC/2S & ASC -8000 25 pin telemetry port and D connector.
- c. Capable of assigning special applications of 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, 24 VDC, Logic Ground and TS2 Mode bits.

6. Serviceability

- a. Electronic modules including the power supply easily removable from the front of the controller using a screwdriver as the only tool. Plug in connector for power and signal connections to the circuit boards.
- b. Allow the removal and replacement of any circuit boards without unplugging or removing other circuit boards, except for the power supply. No more than two boards shall be attached together to form a circuit assembly.
- c. Designed for one side of any circuit board to be accessible for troubleshooting and testing while the controller is still in operation and accomplished without the use of extender cards or card pullers.

B. DISPLAY

1. Dynamic Displays

- a. Provide dynamic displays listed below to show the operational status of the controller and offering additional displays for programming. Possible to place vehicle, pedestrian, and preemption calls from the keyboard while displaying status information.
- b. Intersection status displaying a summary of ring, phase, coordination, preemption and time-based control status.
- c. Controller status display indicating current interval, pedestrian, density, maximum, and maximum extension timing by phase and ring. Display the status of vehicle and pedestrian signal outputs in combination with vehicle and pedestrian calls.
- d. Coordinator status display indicating the command source, current coordination pattern information, local and system cycle count, commanded/actual offset, offset correction, time based control status, hold, force off, vehicle permissive, split count down, split extension, offset from ring 1 and green band indications.
- e. Preemptor status display indicating priority (railroad, fire, emergency) preemptors and bus preemptors with calls, preemptor active, inhibit, and delay status. When a preemptor is active, the display also indicates preemptor interval, timing, duration, and hold status. A portion of the display indicating the controller status during preemption including current status, interval, and timing by phase and ring and the status of vehicle and pedestrian signals for each phase.
- f. Time base status display indicating the current time and date, the current day and week program, the active program step for both coordination pattern and time of day functions, the start time of the next program step, and the highest step used. Also displays the programmed selections of the active coordination pattern and time of day pattern.

- g. Communications status displays for Port 1 (SDLC), Port 2 (terminal) Port 3, Ethernet, and NTCIP.
 - h. Port 1 (SDLC) status display indicating the frame responses from the MMU, the terminal and facilities BIUs and the detector BIUs.
 - i. Ports 2 and 3 status display indicating the interconnect format, transmit, valid data, data error, carrier detect and the last valid command.
 - j. An Ethernet status display indicating the line speed, the line status, the total number of transmitted and received counts and transmitted and received error counts.
 - k. An NTCIP status display indicating the total number of SNMP and STMP transmitted and received counts.
 - l. A detector status display indicating activity for up to 64 detectors. The display shows the detector calls as processed by the controller.
 - m. Flash/malfunction management unit (MMU) status display indicating flash status plus MMU channel, conflict, and monitoring function status. A separate display indicating the results of the controller's comparison of its MMU programming to the programming in the controller.
 - n. An input and output status display indicating the activity of the logic level inputs and outputs to the controller.
2. Programming Displays
- a. Programming displays in the form of menus to aid the operator in entering data from the front -panel keyboard.
 - b. A main menu allowing the user to select a major function of the controller. A submenu shall then be displayed to allow the user to select a sub -function within the major function. A four arrow cursor key allows the user to scroll through programmed data.
 - c. English language and traffic engineering terminology shall be used throughout to facilitate programming. The display organization allows traffic personnel to program the controller without using reference cards or manuals. Data entry and data screens shall be in logical order.
 - d. Programming entries consisting of alpha-numerical values, YES/NO and ON/OFF entries. During program entry, new data is displayed as it is entered. Validated and stored entries only when the consistency check is preformed for entries that are constrained by other programmed data or when the ENTER or cursor key is pressed when they are not.
 - e. An example of constrained data is the sequence of the phases within a ring. Checked with the phase compatibility, phases in the ring and start phases among others.
 - f. An example of non-constrained data is the vehicular extension time entry.

- g. The keyboard entry software shall include context sensitive help screens. Help information accessed by placing the cursor on the data entry in question then pressing the HELP key. Help screens provided for keyboard entered data and shall include at a minimum range, description, and functional operation information for the data entry.

C. PROGRAMMING

1. Programming Methods

- a. Methods listed below shall be available for controller configuration and timing entries. The manufacturer shall be able to provide as off the shelf items firmware and software required to affect the listed methods and to implement network operation with system masters and host PC's.
 - (1) Manual data entry from the front panel keyboard
 - (2) Downloading from telemetry from a system master connected to a host PC in a closed loop system.
 - (3) Downloading from a portable PC-compatible computer via an Ethernet or serial cable.
 - (4) Transfer from one controller to another using the Ethernet port on each controller.
 - (5) Transfer from one controller to another, or restoring for a back up copy, using a data transfer module (data key).

2. Programming Security

- a. A minimum of three access levels available to provide programming security.
 - (1) The highest or supervisor level shall have access to programming entries including setting access codes.
 - (2) The second or data change level shall have access to programming entries except access codes.
 - (3) The third or data display level shall only have access to displayed data. No access code shall be required to display data.
- b. User selectable, four digit access codes provided for the supervisor and data change access levels. Access codes shall initially be set to provide unrestricted access.
- c. If there has been no keyboard activity the controller shall automatically logoff the user after 30 minutes.

3. Programming Utility Functions

- a. A copy function shall permit copying timing data from one phase to another. It shall also permit copying timing plan from one timing plan to another, one detector plan and detector options plan to another, coordination pattern data from one pattern to another and one sequence to another. This feature will facilitate data entry when programming any two or more phases with the same timing values, or detectors with the

same programming, and/or two or more coordination patterns with the same pattern data.

- b. The controller unit shall contain a backup data base with user specified values stored in nonvolatile memory. A copy function shall permit transferring the backup database to the active database.
- c. A memory clear function shall permit the user to clear data entries for the following controller functions, either individually or all at once:
 - (1) Configuration
 - (2) Controller
 - (3) Coordinator
 - (4) Preemptor
 - (5) Time base
 - (6) Detectors
 - (7) Logic Processor
- d. A sign on message shall allow the user to view the controller software version number. This message shall be displayed upon power up until a key is depressed. It shall also be possible to display the sign on message by keyboard selection. The sign on display shall allow a user defined message of up to two lines with 38 characters per line.
- e. The controller shall have the capability to output a memory image of the user programmed settings and intersection configuration data in binary format. This shall allow transferring the memory image data to a data key.

D. ACTUATED CONTROL FUNCTIONS

The controller shall provide actuated control functions and operations required by the NEMA TS2 Standard. In addition, it shall provide the features described in the following paragraphs.

1. Phase Sequence

- a. The phase sequence of the controller shall be programmable in any combination of sixteen phases, eight concurrent groups and four timing rings.
- b. Phase sequence information shall be changeable from the keyboard and stored in EEPROM data memory.
- c. The standard phase sequence of the controller shall also be capable of being altered by coordination, time of day or external alternate sequence command. The alternate sequence commands shall allow reversing the normal phase sequence of each phase pair as shown below:
 - Command A - reverses phases 1 and 2
 - Command B - reverses phases 3 and 4
 - Command C - reverses phases 5 and 6
 - Command D - reverses phases 7 and 8

Command E - reverses phases 9 and 10
Command F - reverses phases 11 and 12

- d. The operator shall be able to select from a library of standard sequences. As a minimum, the following shall be provided:
 - (1) Standard NTCIP sequence
 - (2) Two through eight phase controller
 - (3) Sixteen phase quad left turn controller
 - (4) Four single ring 4 phase controllers
 - (5) Dual TS2 eight phase quad controllers
 - (6) TXDOT three phase diamond controller
 - (7) TXDOT four phase diamond controller
- e. An exclusive pedestrian clearance movement provided that will time and display the pedestrian indications with the vehicle movements remaining in all red.

2. Timing Intervals

- a. Timing intervals shall be programmable from 0-255 in one second increments or from 0-25.5 in one tenth second increments, depending on the function.
- b. Four independent timing plans provided and selectable on a time of day basis or by coordination pattern. Each plan shall contain the following interval timings:

- | | |
|----------------------------------|----------------------------------|
| (1) Minimum Green | (15) Maximum 3 |
| (2) Bike Green | (16) Dynamic Maximum |
| (3) Delay Green | (17) Dynamic Maximum Step |
| (4) Walk | (18) Yellow Clearance |
| (5) Walk 2 | (19) Red Clearance |
| (6) Walk Maximum | (20) Red Maximum |
| (7) Pedestrian Clearance | (21) Red Revert |
| (8) Pedestrian Clearance 2 | (22) Actuations before Reduction |
| (9) Pedestrian Clearance Maximum | (23) Seconds per Actuation |
| (10) Pedestrian Carryover | (24) Maximum Initial |
| (11) Vehicle Extension | (25) Time before Reduction |
| (12) Vehicle Extension 2 | (26) Cars Waiting |
| (13) Maximum 1 | (27) Time to Reduce |
| (14) Maximum 2 | (28) Min Gap |

- c. Guaranteed minimum interval values specified at the time of purchase and shall not be changed or overridden from the keyboard. Values provided for the following intervals:
 - (1) Minimum green
 - (2) Walk
 - (3) Pedestrian clearance
 - (4) Yellow clearance
 - (5) Red clearance
 - (6) Red revert
 - (7) Overlap Green
- d. A bike green interval provided that will replace the phase minimum green if the interval time is larger than the min green time and if a detector input designated as a bike detector has been activated.
- e. Two Walk and Pedestrian Clearance intervals provided for each phase per timing plan. The second Walk and Pedestrian Clearance activated by a time base action plan.
- f. Two vehicle extension intervals provided for each phase per timing plan. The active vehicle extension interval selected by a time base action plan.
- g. If enabled, a Delay Green timer shall delay the vehicle phase from starting until the timer has expired. This shall provide an additional all red for the vehicles movement until the timing is complete.
- h. The Pedestrian Walk interval shall extend from Walk to the smaller of the Walk Max time or the phase maximum in effect with a constant input from the "Walk Extension detector".
- i. Volume density intervals shall include actuations before and cars waiting. Actuations before added shall provide a user specified number of actuations that must occur before adding variable (added) initial time. Cars waiting shall provide a user specified number of actuations, or cars waiting, that must occur before starting gap reduction. Gap reduction shall be initiated by either; time before reduction or cars waiting, whichever reaches its maximum value first.
- j. Capable of dynamically extending the maximum green time for each phase based on vehicle demand. Three maximum green intervals shall be selectable per phase based on either time of day, coordination pattern or external input. The initial interval shall be selectable as Max 1, Max 2, or Max 3. If the phase terminates due to max out for two successive cycles, then the maximum green time in effect shall automatically be extended by a dynamic max step interval on each successive cycle until it is equal to dynamic maximum. If the phase gaps out for two successive cycles, then the maximum green time reduces by the dynamic max step time until it reaches to the original max value.
- k. Each phase shall have a red maximum timing interval. An input (red extension) shall extend the all red period of the assigned phase as long as the detector input is true. This input must be true within the all red

time of the assigned phase to be able to extend the all red period. If this detector fails then the all red extension feature shall be disabled.

3. Overlaps

- a. The controller shall provide sixteen internally generated overlaps (A - P). These shall be individually programmable as standard, other (see Section 5.3.2) or minus green / yellow. The green, yellow and red intervals shall be individually programmable following termination of the parent phase. The overlaps programmed as minus green / yellow overlaps shall provide overlap green when any of the overlap phases are green or when in transition between overlapped phases and a modifier phase is not green. The overlap will be yellow when an overlapped phase is yellow and the modifier phase is not yellow and none of the overlapped phases are next.
- b. The other overlap option shall provide for protected, pedestrian protected, not overlap, trailing, leading and advance green programming.
- c. A protected overlap shall be green, yellow, or red like a normal overlap except its outputs shall be blank when the protected phase is green, or the controller is transitioning to a non included phase.
- d. A pedestrian protected overlap shall be green under the following conditions:
 - (1) When an included phase is green and the protected pedestrian is NOT in walk or pedestrian clearance
 - (2) When the controller is in transition between included phases and a pedestrian protected phase is not next
 - (3) After servicing an included phase pedestrian demand if there is enough time before max out to service the overlap minimum green
- e. The controller shall provide the capability of sixteen pedestrian overlaps. These shall be capable of overlapping the pedestrian displays of any combination of phases with a pedestrian movement.
- f. Overlap functions shall be programmable from the controller keyboard.
- g. The controller shall provide a programmable conditional service feature. When selected, the controller shall service an odd numbered phase once normal service to that phase has been completed and enough time for additional service exists on the concurrent even phase.
- h. A conditional service minimum green time shall be programmable for each phase. This interval shall ensure a minimum green if the phase is conditionally served.
- i. It shall be possible to program the controller to re-service the even phase after conditionally serving an odd phase. Once an even phase has been conditionally re-served, the odd phase shall not be conditionally served again until returning to the concurrent group that is timing.

4. Additional Features

- a. The following features shall be programmable for each phase in each of four separate detector plans:
 - (1) Locking/non-locking detector memory
 - (2) Vehicle recall
 - (3) Pedestrian recall
 - (4) Maximum recall
 - (5) Soft recall No-rest phase
 - (6) Enable Added Initial
- b. Also programmed by phase shall be:
 - (1) Phase in use
 - (2) Exclusive Pedestrian phase
- c. Soft recall shall return the controller to the programmed phase in the absence of other calls.
- d. If a phase is designated as a no rest phase the controller shall not rest in the phase.
- e. The controller shall permit power start and external start to be individually programmed by phase and interval. Start intervals shall be green, yellow red, or yellow with overlaps forced yellow.
- f. During a power start condition, the controller shall be capable of timing an all red or flash interval before the power start phase(s) and interval are displayed.
- g. The controller shall provide guaranteed passage operation on a per phase basis. When selected, this feature shall provide a full passage (vehicle extension) interval when a phase gaps out with a gap in effect less than the vehicle extension interval (preset gap).
- h. The controller shall provide both single and dual entry operation. When selected, dual entry shall cause the controller to ensure that one phase is timing in each ring.
- i. It shall be possible via keyboard selection to inhibit the service of a phase with other phase(s) within the same concurrent group.
- j. The controller shall provide the following additional selectable pedestrian functions:
 - (1) Actuated phase rest in WALK
 - (2) Flashing WALK output
 - (3) Pedestrian clearance protection during manual control
 - (4) Pedestrian clearance through yellow
 - (5) Pedestrian indications remain dark with no call
 - (6) Pedestrian timing shall be capable of being carried over from one phase to another

- (7) Programming shall be provided to inhibit re-service of odd phases (left turns) within the same concurrent group.
- k. The controller shall provide a programmable simultaneous gap termination feature. When programmed, phases in both rings shall gap out together in order to terminate the green interval and cross the barrier.
- l. The controller shall provide automatic flash selection according to the requirements of the MUTCD. Both the flash entrance and exit phases shall be programmable through the keyboard, and flashing shall be controlled by either setting the fault/voltage monitor output to be FALSE or by flashing through the load switch driver outputs. If flash desired through the load switches, both the phase and flash overlap outputs either yellow or red as selected by the operator. Automatic flash will be selectable by external input, system command, or time of day action plan.
- m. The controller provides dimming for selectable load switch outputs. Dimming will be accomplished by inhibiting the selected outputs for alternate half cycles of the 120 VAC line. Dimming controllable by time of day and an external input; both functions must be TRUE for dimming to occur. Programming permits individual dimming of the Green/Walk, Yellow/Ped Clear, Red/Don't Walk outputs for each load switch.

E. COORDINATION

Coordination functions to control intersection cycle lengths, system offset relationships, and phase split percentages provided as a standard feature, with no need for additional modules or software.

1. Coordination Patterns

- a. Provide a minimum of 120 coordination patterns. Each pattern allows selection of an independent cycle length, offset value and split pattern. The coordination patterns selected using telemetry (system), hardwire, or non-interconnected (time base) coordination commands.
- b. The coordination patterns selected by the coordination command using the following formats:

Pattern. This format allows selecting the coordination patterns directly, that is, commanding Plan 1 selects Pattern 1. Pattern command includes 1-120 patterns, pattern 254 shall select free and pattern 255 shall select flash.

Standard. This format allows selecting the coordination patterns using a pattern number derived from a cycle offset split command. Each pattern assignable to a specific cycle offset split combination. The coordination pattern selected using the formula

$$(((\text{Cycle} - 1) * 20) + ((\text{Split} - 1) * 5) + \text{Offset}).$$

TS2. This format allows selecting the coordination patterns as a function of Timing Plan and one of three offsets. With this format a

minimum of 20 Timing Plans available for selection of one of sixty coordination patterns.

- c. The following functions programmable in each coordination pattern:
 - (1) Cycle length
 - (2) Split pattern
 - (3) Offset value
 - (4) Alternate phase sequence
 - (5) Split and offset in seconds or percentage
 - (6) Crossing artery pattern
 - (7) Permissive timing
 - (8) Action plan
 - (9) Coordinated phase split extension
 - (10) Timing plan
 - (11) Actuated rest in walk
 - (12) Phase re-service
 - (13) Ring extension
 - (14) Split demand pattern
 - (15) Ring displacement
 - (16) Directed split preferences
 - (17) Special function outputs
 - d. The following functions shall be programmable for each of the 120 Split patterns:
 - (1) Coordinated phase
 - (2) Split value by phase
 - (3) Omit by phase
 - (4) Min recall by phase
 - (5) Max recall by phase
 - (6) Pedestrian recall
 - (7) Max and Pedestrian recall
2. Cycle Length
- a. One cycle length provided for each coordination pattern. The cycle adjustable over a range of 30-255 seconds in 1-second increments.
 - b. The cycle length serves as the reference time for coordination timing.
- ### 6.3. Synchronization
- c. For systems with a single system sync pulse, coordination timing synchronized to the leading edge of that pulse that serves as the master zero reference for offset timing.
 - d. For hardware systems with multiple sync pulses, the coordinator locks onto the correct sync by trying different syncs and checking for reoccurrence during successive cycles.
 - e. After a valid system sync pulse has been received the coordinator checks for the proper occurrence of the system sync pulse during each subsequent cycle. If a sync pulse does not occur, the coordinator self syncs and continue to operate with the last set of coordination commands for a programmable number of cycles from 0-255. If a sync

pulse does not occur within the programmed period (or until the first sync pulse is received), the coordinator shall revert to the non-interconnected coordination mode.

3. Offset

- a. Offset normally defined as the time period from the system sync pulse to the beginning of the leading coordinated phase green (local zero). The coordinator capable of referencing the offset to the beginning of the lagging coordinated phase green, coordinated phase yield or start of yellow point.
- b. Offsets shall be programmable using both percent and seconds. The range is from 0-99% of the cycle length in 1% increments or 0-254 seconds in 1 second increments. An offset value of 255 results in free.
- c. Offset changes achieved by adding or subtracting cycle time over a maximum of three cycle periods to allow a smooth transition to the new offset. Other offset change methods may be to add 20% to each cycle or to snap to the sync point once the permissive periods are complete and the coordinated phases are green. Offset correction using dwell also selectable.

4. Split

- a. Each split provides a split interval for each of sixteen phases. The split interval is programmable using percent or seconds. The range is from 0-99% of the cycle length in 1% increments or 0-255 seconds in 1 second increments.
- b. Split interval settings determine the maximum time, including vehicle clearance (yellow and red), for a non-coordinated phase, or the minimum time for a coordinated phase. Phase termination controlled by establishing a force off point for each phase within the cycle. Except for the coordinated phases the force off point is selectable to be a fixed point within the cycle or allowed to float. If floating force offs are selected each phase shall time no more than its own split interval.
- c. During coordination, it shall be possible to operate a coordinated phase as actuated or non-actuated. If a coordinated phase is actuated, vehicle detections shall permit the coordinator to extend a phase beyond the normal yield point. Extended coordinated phase green shall be selectable using the same range as split interval settings (percent or seconds). If actuated coordinated phases are used they shall be able to have actuated or non-actuated (walk rest) pedestrian movements.

5. Permissive Periods

- a. Permissive periods provided to control the time period during coordinated phases released to service calls on non-coordinated phases.

- b. Permissive timing begins at the lead coordinated phase yield point. A yield point automatically computed for the coordinated phase in each ring. The coordinated phase yield point allows the coordinated phases to yield independent of each other. The yield point is the point that the coordinated phase is released to allow the controller to service calls on non-coordinated phases. The computation takes into account the coordinated phase split interval plus pedestrian and vehicle clearance times.
 - c. Automatic permissive period operation provided by automatically calculating a permissive period for each non-coordinated phase. The permissive period shall consist of a separate vehicle and pedestrian period computed from the phase split interval and the vehicle/pedestrian minimum time. The controller answers a call only during the associated phase permissive period. However, once the controller has been released to answer a call, remaining phases are served in normal sequence.
 - d. Single permissive period operation provided by defining a single time period per cycle beginning with the yield point during which the controller is allowed to answer phase calls for any phase. The duration of this period will be selectable in each coordination pattern.
 - e. Dual permissive period operation provided. During the first permissive period, the controller answers only vehicle or pedestrian calls on the phases following the coordinated phase. If the controller services a call during this period, calls on the remaining phases are served in normal rotation. During the second permissive period, the controller shall answer calls on remaining phases except the first permissive phase. The duration of the two permissive periods, and the time to start the second permissive period (displacement), will be selectable in each coordination pattern.
6. Phase Re-service
- a. If actuated coordinated phases are in use, it shall be possible to re-service non-coordinated phases within the same cycle if sufficient time remains. A phase shall be re-serviced only if the permissive period for the phase indicates there is sufficient time remaining in the cycle to service the phase.
 - b. Phase re-service shall be capable of being enabled/ disabled in each coordination pattern.
7. Transition Cycles
- a. The controller provides a smooth and orderly transition when changing from free operation to coordinated operation and from one coordination command to another.
 - b. During a free to coordinated transition, the controller shall initiate a pick up cycle beginning upon receipt of a sync pulse and a valid coordination

command. The controller shall then enter coordination mode upon crossing a barrier or if resting in the coordinated phases.

- c. Each coordination command selects a pattern. A command change implements concurrent with a sync pulse. Cycle, offset, and split changes does not take effect until local zero.

8. Crossing Artery Control

- a. The coordinator capable of implementing dual coordination at an intersection where two arterials are under control of separate masters.
- b. An external input enables dual coordination. Once enabled, the coordinator places a continuous call on the crossing artery phases so as to ensure that these remain green for their full split interval.
- c. The coordinator outputs a crossing artery sync signal to indicate the beginning of the crossing artery phase split interval.
- d. Dual coordination forces a selectable crossing artery split plan to be used so as to allow a particular split to be optimized for dual coordination in each coordination pattern.

9. Local Split Demand

- a. The coordinator provides a minimum of two split demand detector inputs that allow the selection of a preferred split plan based on intersection demand.
- b. If the split demand detector indicates continuous vehicle presence during a programmed monitoring period beginning with the onset of a selected phase green, the coordinator forces a selectable split plan to be in effect during the next cycle. This split plan remains in effect for a selected number of cycles from 0 - 255. A specific split plan is capable of being selected in each coordination pattern.

10. Adaptive Split Demand

The coordinator provides a method to select the split using measurement of each phase's green utilization. From the measurement, the coordinator determines which phase or phases had excess time that was not used during the last measurement period. Then the excess time is added to the first set of preferential phases. If the first set of preferential phases gapped out during the last measurement period, then the excess time will be added to a second set of preferential phases. If both sets of preferential phases gapped out during the last measurement period then the time shall be added to the beginning of the coordinated phases.

11. Free Mode

- a. The coordinator provides a free mode of operation, where coordination control is removed.
- b. Free mode operation is selectable by coordination commands, by external input or by keyboard entry.

- c. The coordinator reverts to the free mode when active controller inputs or functions would interfere with coordination. Such inputs or functions include the following:
 - (1) Manual control enable
 - (2) Stop time
 - (3) Automatic flash
 - (4) Preemption
- d. The coordinator provides an active free mode, where coordination control is removed but the coordinator continues to monitor system sync so as to keep its timing in step with the system master.

12. Manual Control

The controller allows manual override of the current coordination command from the keyboard. The manual command allows selection of coordination patterns to be in effect.

13. Interconnect Modes

- a. The coordinator capable of operating with any of the following interconnects types:
 - (1) Non-interconnected coordination (time-based)
 - (2) Telemetry
 - (3) Hardwired
- b. The coordinator is compatible with fixed time interconnect that provides the sync pulse superimposed on the offset lines. Also operates within an interconnected system using a separate sync line. The non-interconnected coordination mode serves as a backup when using telemetry or hardwired interconnect.

14. Master Coordinator

The coordinator shall output the coordination command, including sync pulse. This will permit the controller to be used as a time of day master in a hardwired interconnected system.

F. PREEMPTION

The controller shall provide a minimum of ten preemption sequences that can be programmed as either railroad-fire emergency or bus vehicle preemption sequences. Preemption capability standard and not requiring additional modules or software:

1. Railroad-Fire-Emergency Vehicle Preemption

- a. The ten railroad fire emergency vehicle preemptors selectable as a priority or non-priority Type. Priority preemptor calls overriding non-priority preemptor calls. Low numbered priority preemptors overriding higher numbered priority preemptor calls. Non-priority preemptor calls serviced in the order received.

- b. Each preemptor providing a locking and non-locking memory feature for preemptor calls. If a preemptor is in the non-locking mode and a call is received and dropped during the delay time, the preemptor is not serviced.
- c. Preemptor timing intervals programmable from 0 - 255 in one-second increments or 0 -25.5 in one-tenth second increments, depending on function. Delay, max presence, and duration timing intervals programmed from 0 – 65535 seconds in one-second increments.
- d. A programmable delay time interval shall be provided to inhibit the start of the preemption sequence. This interval shall begin timing upon receipt of a preemption call. This time shall be programmable from 0 - 255 seconds in one second increments.
- e. An inhibit time shall be provided as the last portion of the delay time interval. During this time, phases that are not part of the preempt sequence shall be inhibited from service. This time shall be programmable from 0 - 65535 seconds in one second increments.
- f. A programmable extend input causing the preemptor to remain in the dwell interval following the removal of the preempt call. If a preempt call is reapplied during this time, the preemptor shall revert to start of dwell interval. This time is programmable from 0 - 25.5 seconds in one tenth second increments.
- g. A programmable duration time provided to control the minimum time that a preemptor remains active. This time is programmable from 0 - 65535 seconds in one second increments.
- h. A programmable maximum time provided to control the maximum time that a preemptor input remains active and still be recognized by the controller. Once failed, the input must return to inactive state to be recognized again.
- i. Phase timing at the beginning of a preemption sequence remains in effect for a minimum time before the controller advances to the next sequential interval. If the phase has been timing for longer than the programmed preemptor minimum time, the controller shall immediately advance to the next sequential interval. Minimum times shall be programmable for the following intervals:
 - (1) Green/walk/pedestrian clearance
 - (2) Yellow
 - (3) Red
- j. A phase shall advance immediately to pedestrian clearance if it has been timing a WALK interval at the beginning of a preemption sequence. It shall be possible to time the minimum pedestrian clearance through the yellow interval, or alternately to advance immediately to yellow. During preemption, pedestrian indicators is selectable as being a solid DONT WALK, OFF (blank) or fully operational.

- k. If an overlap is in effect when the preemption sequence begins, it shall be possible to terminate the overlap so that it remains red for the remainder of the preemption sequence. Overlaps terminating or forced to terminate shall time the preemptor minimum yellow and red clearance times.
- l. Each preemptor provides user programmable green, yellow, and red track clearance intervals. Timing begins immediately after the preemptor minimum red interval.
- m. Up to four permissive phases selectable as track clearance phases. During the track clearance period, the selected phases times the track clearance green, yellow and red intervals once, and then advance to the hold interval. If track clearance phases are not selected the track clearance interval omitted from the preempt sequence and is the controller interval timing used if track clearance interval times have been programmed as zero.
- n. The preemption hold interval begins immediately after track clearance. It remains in effect until the preemptor duration time and minimum hold times have elapsed and the preemptor call has been removed or the preemptor maximum time has been exceeded. During the preemption hold interval, any one of the following conditions shall be selectable:
 - (1) Hold phase green
 - (2) Limited phase service
 - (3) All red
 - (4) Flash
- o. Any valid phase, except a track clearance phase, selectable as a hold phase. If hold phases are not selected, the controller remains in all red during the hold interval. If flash is selected for the hold interval, up to two permissive phases shall be selectable to flash yellow, and the remaining phases shall flash red. Overlaps associated with the phases flashing yellow also flashes yellow unless they have been forced to terminate, in which case flashes remain red.
- p. The preemptor shall immediately cause flashing operation if the preemption input and the track interlock input are not in opposite states and the track interlock function is enabled.
- q. Each preemptor provides a user programmable green, yellow, and red hold interval, during which the hold phase(s) shall operate normally, except that the minimum green interval time shall equal the hold green time. At the completion of the hold green interval, the controller times the hold yellow and red clearance intervals before transfer to the exit phases.
- r. Up to four permissive exit phases will be selectable to time after the preemption sequence is completed serving as transition phases to return the controller to normal operation. It shall also be possible to place calls

on selected phases upon exiting preemption. The option causes the preemptor to exit preemption to the correct phase to maintain coordination.

- s. Each preemptor provides a user programmable exit maximum time. Upon exiting the preemption sequence, times shall serve as the maximum green time effective for one controller cycle for all phases except hold phases.
 - t. Preemptor linking permits preemption sequences, where lower priority preemptors may call the higher priority preemptors from their preemption sequence.
 - u. Preemptor active outputs provided for each of the preemptors. The output sets to ON when the preemption sequence begins and remains ON for the duration of the sequence. Possible to program preempt active outputs to be ON only during preempt hold intervals. Additionally, it shall be possible to program the non-active, non-priority preemptor outputs to flash while another preemptor is active.
 - v. Preemptors normally override automatic flash. It will be possible to inhibit this feature for each preemptor.
2. Bus Preemption
- a. Ten bus preemptors provide control for bus or other low priority vehicles. Bus preemptors have low priority and are overridden by railroad/fire/emergency vehicle preemptor calls.
 - b. The preemptor is programmed to accept either a 6.25 pulse per second signal with a 50% duty cycle or a solid input to identify a bus preemptor call. Bus preemptor calls shall be capable of preemptor call memory and served in the order received.
 - c. Bus preemptor timing intervals programmable from 0 - 255 in one second increments or 0 - 25.5 in one tenth second increments depending on the function.
 - d. A re-service time provided to avoid excessive utilization of the same bus preemptor. If a call is received before the re-service time has elapsed, the bus preemptor shall not be re-serviced. If re-service time has not been entered then all phases with a call when leaving the bus preemption sequence shall be serviced before the bus preemptor may be served again.
 - e. Bus preemptors shall provide delay, inhibit, and maximum time functions similar to those for railroad/fire/emergency vehicle preemptors described above.
 - f. Bus preemptors shall provide the following entrance intervals:
 - (1) Green/walk/pedestrian clearance
 - (2) Yellow
 - (3) Red

- g. At the completion of the entrance red clearance, the bus preemptor shall advance to the hold green interval. During this interval, up to four permissive phases shall be selectable to remain green until the minimum hold time has elapsed and the bus preemptor call has been removed or the preemptor maximum time has been exceeded.
 - h. It shall be possible to program the controller to allow concurrent phases to be serviced for a bus preemptor with only one phase selected as the hold interval phase.
3. Preemption Safeguards
- a. If a preemptor call is active when power is restored to a controller, the fault/voltage monitor output shall be set to FALSE, placing the intersection in flash. Similarly, if external start is applied during a preemption sequence, the intersection shall be set to flash. Intersection flash shall remain in effect until the preemptor call has been removed and the preemptor duration time has elapsed.
 - b. An input provided to stop timing of the current active preemptor under control of the MMU/CMU.
 - c. A preemptor safety interlock provided to cause the intersection to go into flash whenever the controller has been removed or has not been programmed for preemption. This is achieved with an appropriate signal to the MMU/CMU.
4. Transit Signal Priority
- a. The controller includes a transit signal priority algorithm that provides for transit vehicle movement through the intersection, while not interrupting coordination or skipping phases.
 - b. Provide a check in detector input that senses the arrival of the transit vehicle. When active this input initiates Transit Signal Priority (TSP).
 - c. A TSP delay shall delay the beginning of TSP operation until a set interval after check in.
 - d. A check out detector input shall determine the departure of the transit vehicle.
 - e. Assignment of a single pulse from the check in detector and check out detector to the controller inputs programmable to any controller input. Including, inputs from devices that continuously pulse (pulsing as long as the vehicle requires TSP) through EVP 1 - 4, for a controller with a C1 connector, or through Preemptor inputs 3 – 6, on a controller with an MSD connector.
 - f. When under coordination the TSP sequence shall use alternate split times to accommodate transit vehicles while maintaining coordination.
 - g. When under free operation the TSP sequence uses alternate maximum times to accommodate transit vehicle while not skipping phase.

G. TIME-BASED CONTROL & NON-INTERCONNECTED COORDINATION

The controller shall include time based control. This capability is a standard feature and shall not require additional modules or software.

1. Clock/Calendar Functions

- a. The controller shall provide a time of day (TOD) clock that is used for all time based control functions. The only required clock settings are the current time (hour, minute and second) and date (month, day and year). Day of week and week of year are automatically computed from the date setting. Also possible to set the number of hours that the local standard time is ahead or behind Greenwich Mean Time.
- b. During normal operation, the TOD clock shall use the power line frequency as its time base. When power is removed, a crystal oscillator maintains the time for up to 30 days. The oscillator has a timing accuracy of $\pm 0.005\%$ over the entire NEMA temperature range as compared to the Universal Coordinated Time Standard.
- c. In addition to entering time and date via the keyboard, it is possible to download the information from another controller, a computer, or a system master.
- d. The controller includes a time reset input. This feature resets the TOD clock to 03:30 whenever the time reset input is TRUE.
- e. The TOD clock automatically compensates for leap year and shall be programmable to automatically switch to daylight savings time.

2. Time Based Control

- a. Time based control utilizes a day plan program format. The month program consists of 200 programmable schedules, each assignable to one of sixteen day programs. Each day program consists of from 1 to 50 program steps that define a program for the entire day. Each program step is programmed with a starting time and an action plan number. The day plans are also assigned to days of the week and days of the month.
- b. Time based control shall use action plans to assign:
 - (1) Coordination pattern number
 - (2) Vehicle detector plan number
 - (3) Controller sequence
 - (4) Timing plan
 - (5) Vehicle detector diagnostic plan
 - (6) Pedestrian detector diagnostic plan
- c. Time based control shall also use action plans to enable:
 - (1) Automatic flash
 - (2) System override
 - (3) Detector log

- (4) Dimming
 - (5) Special functions
 - (6) Auxiliary functions
 - (7) By-Phase functions
 - (a) Pedestrian recall - Walk 2 enable
 - (b) Vehicle extension 2 enable
 - (c) Vehicle recall
 - (d) Vehicle max recall
 - (e) Max 2 enable - Max 3 enable
 - (f) Conditional service inhibit
 - (g) Phase omit
 - d. A minimum of 36 holiday or exception day programs that override the normal day program. Holiday programs capable of being set as floating (occurs on a specific day and week of the month) or fixed (occurs on a specific day of the year) and, possible to program a fixed holiday so that it automatically repeats in the following year.
 - e. Possible to manually force any of the action plans to override the current action plan. The forced plan entered from the keyboard and remains in effect until removed.
3. Non-Interconnected Coordination
- a. A minimum of 200 time base schedule programs shall be available for the day-programs. These shall not have to be entered in any special sequence. It shall be possible to add and delete steps from a day program without affecting any other day-program. Each of the program steps shall permit selection of the following functions:
 - (1) Day program assignment
 - (2) Start time
 - (3) Action plan
 - b. Selection of system override in an action plan allows the coordination pattern selected by the action plan to override the current telemetry or hardwire system commanded coordination pattern.
 - c. When operating in the non-interconnected coordination mode the synchronization point for cycles references to a user selected reference time (sync reference), last event or last sync as selected from the keyboard. The sync reference time is that time at that cycles are reset to zero.
 - d. If the sync reference time is selected, the synchronization point for the cycle selected by the current program step is computed using the present time, sync reference time, and cycle length. The synchronization point occurs whenever the present time is an even

number of cycle length periods has occurred since the sync reference time.

H. DETECTORS

1. Detector Functions

The controller provides a minimum of 64 vehicle detector inputs. Each input is assignable to any phase and programmable as to detector function. Extend and delay timing is provided for each detector. Each detector is capable of operating in a lock or non-lock mode. The controller is capable of providing 16 pedestrian detector inputs. Each pedestrian detector shall be assignable to any phase.

2. Detector Cross Switching

The controller provides detector cross switching that permits vehicle detectors to alternately place calls on assigned phases and assigned cross switch phases. If the assigned phase is not green and the cross-switch phase is green, the detector places calls on the cross switch phase. If the assigned phase is omitted, for any reason, the detector places calls on the cross switch phase.

3. Detector Types

Each vehicle detector is user programmable to operate as one of the following 3 detector types:

Type 0 (zero): supports all NTCIP or standard detector functionality.

Type 1: (GREEN DELAY) The first detection received when the phase goes green is recognized immediately, whether the detector is active when green starts or is activated after the green is timing. Detections received before the first timeout of the extension interval are also recognized immediately. Once the detector extension interval (not the phase extension interval) times out, further detector inputs are recognized only if continuously present for a period equal to the programmed delay time AND the delayed signal is NOT extended. The first detection received when the phase goes green, whether present when green starts or received later, is recognized immediately. Detections received before the first timeout of the extension interval are also recognized immediately. Once the detector extension interval (not the phase extension interval) times out, further detector inputs are recognized only if continuously present for a period equal to the programmed delay time AND the delayed signal is NOT extended.

Type 2: (STOP BAR WITH EXTEND TIME AND RESET) The detector input must be true when assigned phase green starts else the detector is disconnected for the balance of phase green. If the detector input is true when phase green starts the extension timer is reset while the input remains true. When the detector input is removed the extension timer begins running. If another detector input is received before extension time expires, the extension timer

is reset for the duration of the input and once again begins timing when the input goes false. This action is repeated until the extension timer times out, at which time it is disconnected for the balance of phase green.

4. System Detectors

- a. Each detector input shall be capable of functioning as one of 16 system detectors.
- b. Vehicle detectors shall be capable of being assigned to a minimum of 16 speed detectors. Speed shall be detected using both one and two detector configurations. Speed shall be computed using a keyboard entered average vehicle length and loop length for a one detector configuration. When using two detectors, speed shall be calculated using a keyboard entered distance between detectors and travel time between detectors.

I. SYSTEM COMMUNICATION

1. On-Street Master Communications

The controller is capable of communicating with an on street system master. This capability provided by a separate telemetry module that is included in the controller when required by the drawings and specifications. The telemetry module receives system master commands and data transmissions. In addition, it transmits the controller status, data base and system detector information to the system master.

2. System Commands

- a. The telemetry module allows the controller to receive, as a minimum, the following commands:
 - (1) Cycle, offset, and split (coordination pattern)
 - (2) System sync
 - (3) Special function commands (minimum of four)
 - (4) Free and flash mode commands
 - (5) Time and date
 - (6) Request for local status
 - (7) Recall to Max
- b. Commands must occur more than once in any three second period in order to be recognized.
- c. Mode and special function commands cleared after 20 minutes of loss of communication between controller and system master.
- d. Status Data – The status of each of the following functions shall be transmitted to the system master in response to a local status request:
 - (1) Green and yellow status for all phases and overlaps
 - (2) Walk and pedestrian clearance status for all phases

- (3) Vehicle and pedestrian detector status
 - (4) Phase termination status
 - (5) Local time
 - (6) Coordination status
 - (7) Command source
 - (8) Sync or transitioning status of coordinator
 - (9) Conflict flash status
 - (10) Local flash status
 - (11) Preempt activity and calls
 - (12) Volume and occupancy data from a minimum of 16 system detectors
 - (13) Speed data from a minimum of two speed detectors
 - (14) Maintenance required (cabinet door open) status
 - (15) Status of two user-defined alarms
- e. Split Reporting – The status of each of the following parameters calculated on a per-cycle basis and transmitted to the system master:
 - (1) Actual time spent in each phase
 - (2) Time of day at end of cycle
 - (3) Phases forced off during cycle
 - (4) Type of coordination operation
 - (5) Whether transitioning to new offset
 - (6) Cycle, offset, and split in effect during last cycle
 - (7) Flash status if operation is Free
 - f. Upload/Download Capability – The telemetry module provides the capability to upload/download the entire intersection database. Phase assignments for overlaps and preemptors are not to be downloaded to preclude unsafe controller operation. It is possible to inhibit downloading of phases in use and left turn head control. Data transfer shall not require the intersection to be in flash.
3. Telemetry
- a. Telemetry shall utilize TDM/FSK data transmission from 1200 baud to 9600 baud over two pairs of wires. These may be leased lines (Type 3002, voice grade, unconditioned) or dedicated cable. Optional fiber optic communications capability shall also be available.
 - b. The nominal transmitter output level shall be 0 dBm into a 600 ohm load. The receiver sensitivity shall be -34 dBm and adjustable from -40 to +6 dBm.
 - c. Parity and error checking employed to assure transmission and reception of valid data. Indicators provided on the telemetry module to show telemetry activity as follows: transmit, receive carrier, and valid data.

- d. In the event of a telemetry failure, the controller shall revert to the non-interconnected coordination mode after it has self synchronized for a number of cycles, which shall be selectable from 0-255.

4. Communications Protocols

The controller has the capability of supporting communications with traffic management systems using industry standard protocols with the installation of appropriate optional software. At a minimum the controller has optional software to support the following protocols:

CalTrans AB3418

ECPIP

NTCIP

Level 2 as defined by Section 3.3.6 of NEMA TS2 - 2003. NTCIP v02.06 capabilities shall include for NTCIP mandatory and optional objects. The controller vendor provides access to controller data via vendor specific objects. These and other objects supported by the controller are defined in a standard MIB file.

5. Ethernet Communications

The controller has the capability of supporting communications through Ethernet. This communications uses internal circuitry. The Ethernet port supports auto sensing of 10/100 Base T and half or full duplex operation.

6. External Clock

The controller has the capability of communicating with an external clock like a GPS or WWV clock in order to set its internal time of day clock.

7. Communications Ports

- a. The controller shall have as a minimum the following internal communications ports:

- (1) Port 1- SDLC for communications to other devices in the cabinet
- (2) Port 2 - Terminal port for communications with a computer for the purposes of uploading, downloading or upgrading the controller software
- (3) Port 3 - Systems communications port. This port provides either communicate to an on-street master or a central computer system
- (4) An option circuit board is available to expand communications by adding two additional serial communications ports

- b. Serial communications shall operate at 1200 to 115.2 K baud

J. DIAGNOSTICS

1. General Diagnostics Features

- a. The controller includes both automatic and operator initiated diagnostics. This capability is a standard feature and shall not require additional modules or software.

- b. Automatic diagnostics verifies memory, MMU compatibility programming, and microprocessor operation each time power is reapplied to the controller. After power has been applied, diagnostics continually verify the operation of essential elements of the controller including at a minimum: PROM, EE PROM, communications, and the microprocessor.
 - c. Operator initiated diagnostics allows the operator to verify proper operation of controller input, output, communications, keyboard, and display functions. Both manual and automatic test modes are provided.
2. Detector Diagnostics
- a. Time of day controlled detector diagnostics provided to allow testing vehicle and pedestrian detectors for no activity, maximum presence, and erratic output.
 - b. A minimum of eight detector diagnostic plans provided. These plans shall be selectable on a time-of-day basis. This allows varying the detector diagnostic intervals to correspond with changes in detector activity.
 - c. If a detector is diagnosed as failed, the associated phase is placed in one of the following keyboard selectable modes:
 - (1) Detector fail recall from 1 to 255 seconds
 - (2) Maximum Recall
 - (3) Disable the detector from calling or extending.
 - d. Diagnostics for NEMA TS2 detectors connected to the controller using a Bus Interface Unit (BIU) shall also include detection of watchdog, open and shorted loop, and excessive inductance change failures.

K. LOGGING

The controller shall be capable of logging and reporting detector activity, detector failures, and the occurrence of selected events or alarms. Logs shall be capable of being printed or displayed on the front of the controller.

- 1. Detector Logging
 - a. The controller includes a detector log buffer capable of logging volume, occupancy and average speed for selected vehicle and speed detectors.
 - b. The detector logging interval has keyboard selectable as 5, 15, 30, or 60 minutes.
 - c. Detector logging is capable of being enabled or disabled by time of day.
- 2. Detector Failure Logging
 - a. The controller includes a detector failure log buffer capable of storing a minimum of 100 time and date stamped detector failure events. Once logged, detector failure events remain in the log until cleared or the log buffer capacity is exceeded at which time the oldest detector failure events shall be overwritten.

- b. Detector diagnostic failures are recorded in the detector failure log including: no activity, maximum presence, erratic output, watchdog failure, open loop, shorted loop, and excessive inductance change. If a detector recovers after a diagnostic failure, a detector on-line event shall be stored in the detector failure log.
 - c. Detector failure logging shall be capable of being disabled.
3. Event Logging
- a. The controller includes an event log buffer capable of storing a minimum of 200 time and date stamped events or alarms. Once logged, events remain in the buffer until cleared or the log buffer capacity is exceeded at which time the oldest events shall be overwritten.
 - b. At a minimum the following events logged: communication failures, coordination faults, MMU and local flash status, preempt, power ON/OFF, low battery, and status of a minimum of two alarm inputs, and an on line event logged when an event or alarm returns to normal status.
 - c. If security is enabled, an event logged when a user enters a data change. This event includes the user's ID. It is necessary to log the first change only and not every change. Also an entry is recorded when a user logs in and out of the controller.
 - d. Event logging shall be capable of being enabled or disabled for each category of event or alarm.
4. OE logging
- a. The controller accumulates phase utilization data, phase termination data, and detector data for a number of cycles selectable by the operator.
 - b. The MOE log includes the number of gap outs, force offs and max outs per phase.
 - c. The MOE log includes the mode of operation and phase utilization. If the controller is operating under coordination, the log shall include the pattern in effect and the average phase split for each period. If the controller is operating free, the log shall include the timing plan (1 – 4), the maximum in effect and the average phase maximum for each period.
 - d. Each logged period includes the volume, number of stops and the delay per phase.
 - e. Each log period records the number of times a phase was skipped and the number of times walk was served per phase.

L. EMULATION

Emulation Software. With each controller provide software designed to emulate the controller. The emulation software shall employ the full functionality of the controller including but not limited to:

Configuration, timing, coordination, preemption, time base, detector setup, status display, utilities including special logic and diagnostic information.

The software shall employ a graphical user interface that looks and acts like the controller. The software shall be designed to operate on the latest Microsoft Windows operating system and be capable of direct interface with the latest version of Trafficware Synchro traffic modeling software.

Article 17.3 Standard Auxiliary Equipment

Provide equipment meeting the requirements of Section 6 of the NEMA Standard Publication TS 2-2003 V02.06, Traffic Controller Assemblies with NTCIP Requirements (NEMA TS-2).

- A. Three Circuit Solid State Load Switches. The cabinet shall come with sixteen (16) load switches. All load switches shall be cube type and have LED indications for both the input and output side of the load. The load switches shall be PDC model SSS87I/O or approved equivalent.
- B. Solid State Flasher. The cabinet shall come with one (1) flasher. The flasher shall be cube type and have LED indications. The flasher shall be PDC model SSF87 or approved equivalent.
- C. Malfunction Management Unit (MMU). The cabinet shall come with one (1) MMU's that meets all the requirements of NEMA TS2-2003 while remaining downward compatible with NEMA TS1. It shall have (2) high contrast LCD displays and an internal diagnostic wizard. It shall come with a 10/100 ethernet port. It shall come with software to run flashing yellow arrow operation. The MMU's shall be an Eberle Design, Inc. model MMU2-16LEip or approved equivalent.
- D. Flash Transfer Relay. The cabinet shall come with eight (8) heavy duty flash transfer relays. The flash transfer relays. The relays shall be Detrol Controls model 295 or approved equivalent.
- E. Inductive Loop Detectors Units. Provide sixteen (16) inductive loop detectors that conform to the requirements of NEMA TS-2, Section 6.5 Inductive Loop Detector Units. Unless otherwise called for in the Drawings provide 4 Channel Inductive Loop Detectors.

The loop amplifiers shall be Eberle Design, Inc. model ORACLE4e or approved equivalent.

- F. Local Coordination Units. Provide actuated coordination that conforms to the requirements of NEMA TS-2, Section 3.6 Actuated Coordination.
- G. System Modem/Interface Unit. The cabinet shall come with an 8 pair copper ethernet switch. Four ports of 10/100TX and a 1000base SFP port. The ethernet switch shall support all of the following minimum requirements; EFMplus technology, virtual local area networks (VLAN) tagging (IEEE 802.1q) and dynamic bridging (IEEE 802.1). The copper ethernet device shall provide for communication over copper pairs split into two directions and the high speed link shall be over bonded copper pairs (IEEE 802.3ah 2Base-TL. The copper ethernet switch shall

be an Actelis Networks model ML698E or approved equivalent. The following items shall be supplied with the copper ethernet switch:

1. Two quad DSL cables 504R20110
2. One AC power adapter 506R00006
3. Four Cat6 patch cables three feet
4. One SFP Optics 100base FX SM 1310nm 15km LC 506R00032
5. Carrier-class element management system
6. Wall mounting kit 510R21080

H. Preemption Units. Provide preemption that conforms to the requirements of NEMA TS-2, Section 3.7 Preemption and the following:

Install the following components of the GTT Company's Opticom Priority Control System according to GTT's written installation instructions at the signalized intersections listed on the Drawings.

1. EVP Infrared Preemption

- a. The system must be capable of sending a signal to the controller when an Opticom signal from a vehicle-mounted "GTT OPTICOM Emitter" has been received and maintained for a period of 1.7 seconds.
- b. Use Opticom Priority Control System Model 792H emitters.
- c. Unless otherwise shown on the Plan use Opticom Traffic Control Systems Opticom Detector Model 721 preemption detectors.
- d. Furnish one (1) Opticom Traffic Control Systems 764 Phase Selectors. Use rack mounted phase selectors.
- e. The controller cabinet shall be wired with a Model 768 Auxiliary Interface Panel and a Model 757 Auxiliary Harness for the full utilization of all auxiliary detector and green sensing operations of the 764 Phase Selectors.
- f. The controller, rather than the phase selector or auxiliary logic, must perform interval timing, signal sequences, and phase skips.

2. GPS Preemption Unit

- a. The system must be capable of sending a signal to the controller when an Opticom signal from a vehicle-mounted "GTT OPTICOM Emitter" has been received and maintained for a period of 1.7 seconds
- b. Unless otherwise shown on the Plan use Opticom Model 3100 GPS/Radio Unit containing a GPS receiver with Antenna and a 2.4 GHz spread transceiver with antenna.

3. Preemption Emitters

When emitters are required, provide GTT Opticom Priority Control System, Model 792H Emitter with 793 in vehicle switch. The Emitter shall be factory

programmed to the class and vehicle identification numbers assigned by jurisdiction as shown in the Drawings and the following:

- a. Provide one copy of 790IS Emitter Software Kit including "Y" cable.
 - b. One GTT Opticom Portable Emitter Kit with 792R emitter on a magnetic base, 793R switch and cigarette lighter adapter power cord in a "Camera Bag" case.
- I. Bus Interface Unit (BIU). Provide six (6) BIUs that fully meet the requirements of NEMA TS-2 Section 8. Unless otherwise called for in the Drawings provide BIUs that meet the NEMA designation BIU2. All BIUs shall provide separate front panel indicator LED's for DC power status and SDLC Port 1 transmit and receive status. The (BIU)'s shall be Eberle Design, Inc. model BIU700 or approved equivalent.
- J. Power supply. Provide a shelf mounted power supply that conforms to the requirements of NEMA TS-2 Section 5.3. The power supply shall be Eberle Design, Inc. model PS250 or approved equivalent.

Article 17.4 Special Auxiliary Equipment

When identified on the Drawings, provide equipment meeting the requirements of the cited Sections of the NEMA Standard Publication TS 2-2003 V02.06, Traffic Controller Assemblies with NTCIP Requirements (NEMA TS-2).

A. Traffic Monitoring Video Camera System

1. Furnish an Axis Q6010-E 60 Hz Camera with the following:
 - a. Micro SDXC card with a capacity of 256GB and speed class U3 or V30.
2. Furnish an Axis Q6075-E 60 Hz Camera with the following:
 - a. Micro SDXC card with a capacity of 256GB and speed class U3 or V30.
3. Furnish an Axis T8144 single port, High PoE midspan, 60 W Industrial Midspan.
4. Furnish an Axis T91L61 pole mount for camera

Article 17.5 Controller Cabinet

Contractor shall provide a controller cabinet that meets the requirements of NEMA Standard TS 2-2003 V02.06 Traffic Controller Assemblies with NTCIP Requirements (NEMA TS-2), Section 5 Terminals and Facilities and Section 7 Cabinets. Cabinet enclosure shall be UL listed.

A. Standard Features. Supply the following standard features:

1. Materials

Unless otherwise designated in the Drawings, provide cabinets constructed of sheet Aluminum. Back and sides of cabinet shell shall be of one continuous piece of Aluminum. Shall be fabricated from 5052-H32 0.125-inch thick aluminum.

2. Cabinet Enclosure

Unless otherwise designated in the Drawings, provide a size 6 cabinet as defined in NEMA TS-2 Table 7-1 and the following:

- a. The cabinet shall be doubled-flanged where it meets the cabinet door.
- b. C channel rails shall be installed on the inside of the cabinet on the back and side walls for the mounting of shelves and panels. Rails shall be welded to the cabinet walls.
- c. All External fasteners shall be stainless steel. Pop rivets shall not be allowed on any external surface.
- d. All exterior seams shall manufactured with a neatly formed continuously weld construction. All welds shall be free from burrs, cracks, blowholes or other irregularities.
- e. The cabinet shall come with lifting ears affixed to the upper exterior of the cabinet. These ears shall utilize only one bolt for easy reorientation.

3. Doors

- a. The cabinet main door shall contain two (2) flush mount locking recessed compartments. The upper compartment that houses police accessible switches and a lower compartment that houses a generator bypass switch and receptacle. The police and generator doors shall be recessed into the main door so that the police door is flush with the main door. A closed-cell, neoprene gasket seal shall be bonded to the enclosure doors. A stiffener plate shall be welded across the width of the inside of the main door to prevent flexing. A main door bar stop shall be a two-position, three-point stop that accommodates open-angles at 90, 125, and 150 degrees. A louvered air entrance located at the bottom of the main door shall satisfy NEMA rod entry test requirements for 3R ventilated enclosures. Bearing rollers shall be applied to ends of door latches to discourage metal-on-metal surfaces from rubbing. The lock assembly shall be positioned so handle does not cause interference with key when opening the door. The door handle shall be $\frac{3}{4}$ " round stock stainless steel bar. The door shall be mounted with a single continuous stainless steel piano hinge that runs the length of the door. Attaching tamper resistant bolts shall also be stainless steel.
- b. The cabinet main door shall be equipped with an OLYMPUS Lock, Inc. # 725RSL or equivalent. A Best™ blue core shall be supplied in the lock. Provide two (2) Best™ blue core keys for the lock assembly.
- c. Provide a Police Compartment meeting the requirements of NEMA TS-2 Section 7.5.7. Provide two (2) keys for lock. The Police Compartment shall house the following switches:
 - (1) "Auto/Flash" switch.-There shall be a switch for the police that puts the cabinet into flashing operations. The switch shall have two positions, "Auto" (up) and "Flash" (down). The "Auto" position shall

allow normal signal operation. The "Flash" position shall immediately cause all signal displays to flash as programmed for emergency flash and apply stop time to the controller. When the police flash switch is returned to "Auto", the controller shall restart except when the MMU has commanded flash operation. The effect shall be to disable the police panel switch when the MMU has detected a malfunction and all controller and MMU indications shall be available to the technician regardless of the position of the police flash switch. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

- (2) "Signals ON/OFF" switch. There shall be a switch that renders the field signal displays electrically dead while maintaining controller operation for purpose of monitoring controller operations. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.
- (3) Permanently label switches in the Police Compartment. Label both the front side and back side of panel. Including switch pin numbering labeling on the back side of panel.
- (4) The weld for the police compartment shall be done on the inside of the cabinet door. All welds shall be free from burrs, cracks, blowholes or other irregularities.

d. Provide Generator Bypass Compartment

- (1) The cabinet front door shall have a locking generator bypass compartment that shall be used to connect a generator to operate the cabinet during extended loss of service line power. The generator compartment shall be capable of being closed and locked while a generator is connected. The mechanism for allowing generator cable access, while the compartment is closed, shall be an integral part of the generator bypass door, via a sliding panel that will normally be in the closed weather tight position. Inside the compartment there shall be a silkscreened panel housing a Hubbell HBL2615 30A / 125V flanged inlet receptacle capable of accepting a standard generator plug, a BACO HC52DQG cam switch with split AC+ and AC- feeds, and (2) LED lamps with sockets. One LED shall be illuminated when the cabinet has service line power and the other when the cabinet is under generator control. All LED's shall be field replaceable without putting the intersection in flash and shall carry a 5 year manufacturer warranty.
- (2) All wiring to the generator bypass compartment shall be contained in a single cable bundle. The cable shall connect to the backside of the electrical components and shall only be accessible from the inside of the cabinet front door. All electrical components on the inside of the front door that carry AC voltage shall be covered by a see-through plexiglass cover. The generator bypass cable shall terminate at the same power panel location as service line voltage.

- (3) The generator bypass compartment shall be equipped with a universal lock bracket capable of accepting a Best™ style lock. The lock shall be an OLYMPUS Lock, INC. # 725RL-DR-RH or equivalent. With tapered spring plunger latch style lock. A Best™ blue core shall be supplied in the lock.
- (4) The welds for the generator bypass compartment shall be done on the inside of the front door. All welds shall be free from burrs, cracks, blowholes or other irregularities.

4. Shelves

Provide shelves meeting the requirements of NEMA TS-2 Section 7.6. Cabinet shall come with two (2) double beveled shelves 10" deep that are reinforced welded with V channel, fabricated from 5052-H32 0.125-inch thick aluminum with double flanged edges rolled front to back. The shelves shall have slotted holes every 7" on the bottom flange of the rolled edges for tying off wire bundles.

A slide-out computer shelf 16" long by 12" wide by 2" deep shall be installed centered underneath the bottom equipment shelf. The shelf shall have a hinged cover that opens from the front and shall be powder-coated black. It shall be a General Devices Part #VC4080-99-1168. The drawer when fully extended shall hold up to 50lbs.

5. Finish and Preparation

The cabinet shall be supplied with a natural mill finish inside and out. All exterior seams shall be manufactured with a neatly formed continuously weld construction. The weld for the police compartment and generator bypass compartment shall be done on the inside of the cabinet door. All welds shall be free from burrs, cracks, blowholes or other irregularities.

6. Cabinet Mounting

- a. Provide cabinet mounting features as defined NEMA TS-2 Section 7.8.
- b. The cabinet manufacturer is responsible for providing a cabinet that shall mount without modification on the foundation detailed in Municipality of Anchorage Standard Specifications, Section 80-4 and Details 80-5, 80-6, and 80-7.

7. Cabinet Ventilation

Furnish a cabinet that fully meets the requirements of NEMA TS-2 Section 7.9 and the following:

- a. Furnish the fan and cabinet vent with internally mounted metal covers that are fabricated to close off the flow of air during winter operation. The cabinet shall be provided with one (1) finger safe fan mounted on the right side of the cabinet plenum and shall be thermostatically controlled (adjustable between 4-176° Fahrenheit). The ceiling exhaust fan plenum edges shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.

- b. Equip the cabinet with a selectable, 600/900/1500 watt cabinet heating device with a 2 speed fan. The heating device must have a remote air sensing thermostat. The contacts must be rated 20 amps, 120 volts, 60 hertz. The heater shall be mounted on the cabinet door. Heating device shall be a Caframo model 9206CA-BBX or approved equivalent.
 - (1) Construct the thermostat so that contacts close on descending temperature and are adjustable between -30 and 110 °F ±5 °F. The contacts must open on rising temperatures of 15 °F above the closing temperature. The adjustment must have an indicating pointer. Remote bulb type thermostat shall not be used. Thermostat shall be a Johnson Controls model A19BBC-2C or approved equivalent.
 - (2) Connect the thermostat in series with an electrical resistance heater and blower fan. The blower fan must be rated for continuous duty. The heater and fan must be connected in parallel and rated 120 volts, 60 Hertz. Mount the unit on the cabinet door below the auxiliary panel.
 - (3) Do not block the air intake or outlet. Provide the unit with a SPST manual override switch that bypasses the thermostat to enable the fan and heater to operate at warmer temperatures.
- c. The cabinet shall come with two (2) dual-ply Dustlock™ Media polyester, disposable air filters; and the filter performance shall conform to listed UL 900 Class 2 and conform to MERV-8 & ASHRAE Standard 52.2-1999. The filter element shall be secured to louvered entrance on the main door with a metal filter cover. The filter and metal cover shall be secured to entrance on main door by two (2) horizontally mounted restraints.

8. Auxiliary Cabinet Equipment

- a. Light fixture. The cabinet shall have two (2) LED lighting fixtures with 15 high power LEDs using a cool white color emitting 300lm min @ 12VDC/750mA. The LED fixtures shall be a Rodeo Electronics TS-LED-05M02. It shall be powered by a Mean Well class 2 power supply LPV-20-12 that shall be mounted on the inside top of the cabinet near the front edge. The cabinet light circuit shall be designed so a second LED fixture will be installed in the cabinet below the rollout drawer without the need a of a second power supply. It shall be attached so that it remains stationary when drawer is extended. An on/off switch that is turned on when the cabinet door is opened and off when it is closed shall activate the lighting fixture(s) power supply. The lighting fixture “ON-OFF” switch must be a toggle switch mounted on the on the inside control panel.
- b. Provide one (1) paper set of complete and accurate cabinet drawings with each cabinet. Make cabinet drawings available electronically in AutoCAD and deliver with paper set. The cabinet shall be furnished with one (1) complete set of cabinet prints. All cabinet wiring and layout shall

come on (1) E1 size sheet, multiple pages shall not be allowed. Provide one (1) flash drive with AutoCAD cabinet drawing for the cabinet wiring.

- c. Provide one paper set of manuals for the controller, Malfunction Management Unit, GTT Opticom Phase Selector and vehicle detector amplifiers with each cabinet. Make said manuals available in electronic Adobe "pdf" format and deliver with paper set.

9. Cabinet Wiring

All wiring shall conform to NEMA TS2 section 5.2.5 and table 5-1. Conductors shall conform to military specification MIL-W-16878D, Electrical insulated high heat wire, type B. Conductors #14 or larger shall be permitted to be UL type THHN. Furnish controller cabinets wired to accommodate:

- a. Configuration #4 in Table 5-2 of the NEMA Standards Publications No. TS 2-2003 V02.06, Traffic Controller Assemblies with NTCIP requirements with four each Type 2 detector racks.

- (1) Equip the cabinet with required control and auxiliary equipment connecting cables to operate the phases and detection indicated on the Drawings, including future use with a minimum of 16 load switch positions, 8 flash transfer relay position and 1 flasher socket.
- (2) Size wiring, switches, surge protectors, flash relays, and flashers to handle the necessary amperage required under full cabinet use. Use orange colored wires to run from the flash transfer relay used for emergency flash programming.
- (3) Wire the cabinet to accommodate 6 unique preemption sequences as defined by NEMA TS-2 Section 3.7 and 2 auxiliary preempt sequences. Configure two detector racks to accommodate 4 unique sequences.
- (4) Wire the cabinet with a GTT Company's Opticom Priority Control Model 768 Auxiliary Interface Panel and a Model 757 Auxiliary Harness to accommodate the full quantity of emergency preemption inputs and green sense operations available with GTT Company's Opticom Priority Control System 764 series phase selector.

Wire in a single Model 757 Auxiliary Harness for the GTT Opticom Model 764 Phase Selector operation and terminate the harness with a connector on Detector Rack No.1. Leave sufficient slack in the wiring harness so that it can reach the connection on Detector Rack No. 2. This panel shall have a protective plastic cover.

Locate the Model 768 Auxiliary Interface Panel between the shelves on or near the left wall. This panel shall have a protective plastic cover. If the panel isn't fully covered from above by the upper shelf, the protective cover will need to extend up and over the panel.

- (5) Wire the cabinet so that the control panel's momentary contact test switches for vehicle calls Phase 1-8 are wired to Detector rack Channels 1-8 respectively.
- (6) Wire the cabinet so that each inductive loop detector channel input termination has three adjacent screw terminal positions provide, so that two loops can be series terminated for each individual detector channel.
- (7) Wire the cabinet so that there is a single field terminal wired to each of the cabinet's flasher outputs circuits #1 and #2.
- (8) Wire the cabinet so that channel 1-16 green field outputs are jumpered to a terminal block. Also, route the GTT Opticom phase selector green sense wires to adjacent positions on the terminal block.
- (9) Wire cabinet so that there are terminal block locations (test points) for all T&F BIU's #1 & #2 wiring circuits.
- (10) Provide a load resistor panel with 8 resistors for usage to "load" future circuits for Flashing Yellow Arrow (FYA) operation.
- (11) Wire all preemption outputs from the detector racks to a terminal block. Wire BIU wires for preemption inputs to adjacent positions on same terminal block. Intended for wiring programming of alternative assignment (Preempt 2-5 or Preempt 3-6) for emergency vehicle preemption.
- (12) Wire the cabinet so that confirmation lights are activated via controllers Preempt Active Outputs, not phase selector confirmation light outputs.
Wire the cabinet so that preemption confirmation light circuits utilize the yellow outputs of LS9 – LS12.
Wire all BIU preemption outputs wires to a terminal block. Wire conductors for LS9 – LS12 yellow inputs to adjacent positions on the same terminal block. Intended for wire programming of alternative confirmation light assignments.
- (13) Terminate the MMU wires associated with channel # 9–12 yellow outputs on a terminal block, for future use. Install conductors from channel # 9–12 yellow field terminals to adjacent positions on the same terminal block.
- (14) All wires terminated behind the main panel or on the back side of other panels shall be SOLDERED. No pressure or solder-less connectors shall be used.
- (15) All cabinets shall be wired for alternative flashing options for all channels. Flashing operation shall alternate between channels 1,3,5,7,13,14,15,16 and 2,4,6,8,9,10,11,12. Flash programming shall be either red, yellow or no flash operation simply by changing wires on the front of the load-bay.

- (16) Wire size 16 AWG or smaller at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. All wires shall have lugs or terminal fittings when not soldered. Lap joint/tack on soldering is not acceptable. All soldered connections shall be made with 60/40 solder and non-corrosive, non-conductive flux. All wiring shall be run neatly and shall use mechanical clamps and conductors shall not be spliced between terminations. Cables shall be sleeved in braided nylon loop and wires shall not be exposed.
- (17) A detector panel shall support four (4) channels of emergency vehicle preemption and eight (8) channels of auxiliary emergency vehicle preemption on a single panel. The emergency preempt wires shall be color coded as follows. +24VDC orange, preempt inputs yellow and ground blue. The auxiliary emergency vehicle preemption shall be white with a yellow tracer. This panel will be mounted on the left side of the cabinet below the level of the bottom shelf. Provide the following terminations points Ch. A/B 24VDC, Ch. C/D 24VDC, Ch. A/B Gnd, Ch. C/D Gnd., in addition to termination positions for the 12 emergency preemption detector inputs.
- (18) All wire cable bundles shall be encased in flex or expandable braided loom along their entire free length.
- (19) The SDLC hub shall have nine (9) ports. Eight (8) of those ports shall be screw down connections, with the remaining connection having for spring clip connection. Mount the panel on left wall between the shelves.
- (20) All SDLC cables shall be terminated on both ends, securely terminated to the SDLC interface panel with screw type connection and professionally routed in the cabinet interior to easily reach the load bay, controller, malfunction management unit and detector racks. All SDLC connectors shall be fully populated with 15 pins each. The SDLC cable's drain wire shall only be connected to Pin 12 on the equipment end connection of each cable.
- (21) All load switches, flasher, and flash transfer relay sockets shall be marked and mounted with screws. Rivets and clip-mounting is unacceptable.
- (22) The use of plug and play modules shall not be allowed, except for in detection rack(s).
- (23) The cabinet shall be wired to provide a 55-pin controller "A" connector. The cabinet shall also be wired to provide a 10-pin controller "A" connector.
- (24) Mount the power supply interface panel on the left wall between the shelves. Provide a clear plastic cover material with be a minimum thickness of 0.1". Cover shall be firmly attached.
- (25) BIU wires connection to the PCB of the load bay BIU rack (T & F 1 & 2) shall be two (2) 34 pin connectors. These connectors shall have locking latches.

- (26) Used BIU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to functions of BIUs. BIU load switch drivers shall be soldered directly to load switch sockets.

10. Field Terminal Blocks

Provide Terminals and Facilities meeting the requirements of NEMA TS-2 Section 5, Configuration #4 (Table 5-2) and the following:

- a. The field terminal blocks shall have No. 10 screw type terminals rated for 600V which are capable of accepting no less than three (3) No. 12 AWG wires fitted with spade connectors. Two (2) rows of four (4) 12-position terminal blocks shall be provided across the bottom of the main panel for terminations of field wiring. Spade lugs from internal cabinet wiring are not allowed on field terminal screws.

There shall be a third row above said terminals, of four (4) 12-position terminal blocks with No. 10 screw type terminals above the field terminal blocks. These blocks shall operate the flash program. It shall be changeable from the front of the load-bay.

The two rows of field terminations shall be tied together in series. Each channel shall have six (6) terminations, two (2) complete rows each consisting of three (3) terminations from left to right beginning with Channel 1 corresponding to the appropriate channel Green, Yellow and Red outputs and following the order of the load switches. Connections shall be soldered on the back sides of the terminal blocks.

Default wiring shall be left to right Green, Yellow, Red for vehicle phases channels 1-8, Walk, Yellow, Don't Walk for pedestrian phase channels 9-12 and Green, Yellow, Red for vehicle phases channels 13-16 following the order of the load switches.

- b. Terminate conductors from the controller unit and MMU unit in ring type terminal lugs or solder them to a through panel solder lug on the rear side of the terminal. Terminate other conductors in spade type terminal lugs.

MMU conductors connections on field terminal blocks shall be soldered on the back side of the terminal blocks.

A ring type terminal connector shall be used for any screw terminal and stud terminal connection of conductors to the power supply interface panel, the power terminal block on the load bay panel and to terminal blocks and components on the power panel.

- c. Do not bring more than 3 conductors to any one terminal. Two flat metal jumpers, straight or U shaped, may also be placed under a terminal screw. Fully engage at least 2 full threads of terminal screws when the screw is tightened. Do not extend live parts beyond the barrier.
- d. A TII Porta Systems Model No. 1512 building entrance protector 12-pair unit shall be installed for telemetry cable pair terminations. A 3M 2810-HCO/87-DPM cross connect terminal block with pigtailed and a 3M 80-6113-3163-0 frame shall also be installed. The building entrance

protector unit and the cross connect terminal block with frame will be mounted on a common panel on the right side of the controller cabinet.

- e. On the right side of controller cabinets, install two 16 position bus bars, for terminating the equipment grounding and neutral conductors used inside the cabinets. On the left side of the controller cabinets, install two 32 position bus bars, for terminating the equipment grounding and neutral conductors from field wiring. Offset upper 16 position bus bar past the lower 16 position bus bar where 32 positions are required.
 - f. The power terminal block on the load bay shall be No. 10 screw type terminals capable of accepting no less than three (3) No. 12 AWG wires fitted with spade ring terminal type connectors. One (1) 12-position terminal block shall be provided horizontally on the top right side of the load bay. The placement of the power terminal block on any other panel shall not be allowed.
11. Cabinet Accessories

See NEMA Standard TS 2-2003 V02.06, Section 5 Terminals and Facilities, Figure 5-4 Cabinet Power Distribution Schematic for Items "a." through "f."

- a. Disconnecting Means
 - (1) Main circuit breaker must be a single pole, 40 ampere, 10,000 amperes interrupting capacity for each cabinet.
 - (2) Provide two (2) Auxiliary circuit breakers, each must be single pole, 20 ampere, 10,000 amperes interrupting capacity. One auxiliary circuit breaker shall only service a single outlet receptacle for exclusive use for the cabinet heater. The other auxiliary circuit breaker shall service the fan, cabinet lights and GFIC outlet. The rating of the main disconnect means with overcurrent protection must be not less than 125% of the maximum anticipated continuous load. When using disconnecting circuit breakers, use "trip indicating trip free" type.
- b. Signal Bus. Connect the signal bus to the incoming AC line through a signal bus solid state relay and an overcurrent protection device. Energize the signal bus solid state relay to provide power to the signal bus. The current rating of the signal bus solid state relay must be at least the current rating of the main overcurrent protection device. Solid state relay shall have an LED input status indicator.
- c. AC Service Transient Suppression. Connect the transient suppression device for the primary feed of the cabinet on the load side of the cabinet overcurrent protection device. The transient voltage suppression device connected to the controller power circuit must provide protection against voltage abnormalities of 1 cycle or less duration.
 - (1) The suppressor must be solid state high energy circuit containing no spark gap, gas tube, or crow bar component. The current rating of the device must be 15 amps minimum. The device must provide transient protection between neutral and ground, line and ground,

as well as line and neutral. If the protection circuits fail, they must fail to an open circuit condition. The device must meet requirements of UL Standard 1449.

- (2) The suppressed voltage rating must be 600 volts or less when subject to an impulse of 6,000 volt, 3,000 amp source impedance, 8.0/20 microsecond waveform as described in UL Standard 1449. In addition, the device must withstand, without failure or permanent damage, one full cycle at 264 volts RMS.
 - (3) The device must contain circuitry to prevent self induced regenerative ringing. There must be a failure warning indicator light that must illuminate when the device has failed and is no longer operable. The transient suppression device must withstand a 20,000 ampere surge current with an 8x20 microsecond (time to crest x time to second halfcrest) waveform 20 times at 3 minute intervals between surges without damage or degradation to the suppressor. Output voltage must not exceed 500 volts at any time during the test. Use a device that is a solid state, high energy circuit with no spark gap, gas tube, or bar component.
- d. Radio Interference Suppression. Equip each traffic cabinet, flasher, and other current interrupting device with a suitable radio interference suppressor installed at the input power point. Install the radio interference suppressor after the AC service transient suppression unit described in Article 17.5 A 11.c. It must provide a minimum attenuation of 50 decibels over a frequency range from 200 kilohertz to 75 megahertz, when used with normal installations.
- (1) The interference suppressor must be hermetically sealed in a substantial metal case filled with suitable insulating compound. Terminals must be nickel-plated, 10-24 brass studs of sufficient external length to provide space for connecting two No. 8 conductors and must be so mounted that the terminals cannot be turned in the case. Ungrounded terminals must be properly insulated from each other and must maintain a surface leakage distance of not less than 1/4 inch between any exposed current conductor and any other metallic part, with an insulation factor of 100 to 200 megohms dependent on external circuit conditions.
 - (2) The radio interference suppressor must have a minimum current rating equal to the rating of the main disconnect means as specified in Article 17.5 A 11.a (1). It must be designed for operation on 120 volts, 60 hertz, single phase circuits and be UL and EIA compliant.
 - (3) Connect the ground connection of the radio interference suppressor only to AC neutral. Do not connect to Earth Ground directly.
- e. Communications Transient Suppression. Provide eight (8) 5-pin gas tube/overcurrent protector modules with PTCs. Modules shall have an

orange case. The module shall be a Tii part No. 195-6C9EM-NL or approved equal.

- f. Control Panel. Provide a control panel assembly that is mounted to the interior side of the police panel compartment on the cabinet door. The control panel assembly must consist of:
- (1) "Controller ON/OFF" switch. There shall be a switch that renders the controller and load-switching devices electrically dead while maintaining flashing operations for purpose of changing the controller or load-switching devices. The switch shall be a general-purpose bat style toggle switch with 0.688" long bat. Label and rate the switch for load current.
 - (2) "Cabinet Light ON/OFF" switch. There shall be a switch that turns off the cabinet light when the door is opened. The switch shall be a general-purpose bat style toggle switch with 0.688" long bat.
 - (3) "Auto/Flash" switch. There shall be a switch that places the field signal displays in flashing operation while the controller continues to operate. This flash shall have no effect on the operation of the controller or MMU. The switch shall be a general-purpose bat style toggle switch with 0.688" long bat.
 - (4) "Stop Time AUTO/OFF/ON" switch. There shall be a 3-position switch labeled "Auto" (up), "Off" (center), and "On" (down). With the switch in the "Auto" position, a stop timing command shall be allowed to be applied to the controller by the police flash switch or the MMU (Malfunction Management Unit). When the switch is in its "Off" position, stop timing commands shall not be applied the controller. The "On" position shall cause the controller to stop time. The switch shall be a general-purpose bat style toggle switch with 0.688" long bat.
 - (5) "Heater By-pass ON/OFF" switch. There shall be a switch to bypass the remote heater thermostat & allow power to the heater unit.
 - (6) "Coordination AUTO/FREE" Switch. When the switch is in the "Auto" position, the local controller must use the local coordinators time of day plan. When the switch is in the "Free" position, it will disable the controller coordination plan. The switch shall be a general-purpose bat style toggle switch with 0.688" long bat.
 - (7) "Force-Off" Switches. There shall be 2 momentary test switches, one tied to ring 1 and the other tied to ring 2 on the controller. Switches must provide tactile feedback and be rated at 1 ampere, minimum, for a resistive load at 120 VAC and at 28 VDC. Contacts must be coin silver or gold plated and be enclosed and labeled as to their function.

- (8) Both sides of the panel shall be silkscreened. Silk-screening on the backside of the switch panel shall be upside down so that when the panel is opened for maintenance the silk-screening will be right side up. The backside silk screening shall include terminal/pin numbers.
 - (9) Provide a hinged clear plastic cover over the control panel switches. Plastic cover shall be of a minimum thickness of 0.1”.
 - (10) The control panel shall be secured to the police panel compartment by two (2) screws on the top and shall be hinged at the bottom to allow access to the soldered side of the switches with the use of only a Phillips screwdriver.
- g. Receptacle Outlets. The cabinet shall be wired with one (1) duplex convenience outlet with a ground fault interrupter, one (1) convenience quad outlet without ground fault interrupters and one (1) single outlet, exclusively for the heating device without ground fault interrupter. The ground fault outlet shall be mounted on the right side of the cabinet on or near the power panel. The convenience quad outlet shall be at the top of the “C” channel on the right wall. The heater outlet shall be mounted on the right wall on or above the power panel. No outlets shall be mounted on the door. The GFI power shall be fed through the auxiliary breaker. The convenience 6 outlet power strip shall be fed through a transient voltage suppressor located on the cabinet power panel. There shall be a 2-position terminal block on the power panel, between the power strip and the voltage suppressor.
 - h. Power panel location and cover. Mount power panel on the right wall below the lower shelf. Provide a clear plastic cover material with a minimum thickness of 0.1”. Cover shall be firmly attached at four points. Holes shall be slotted for easy removal and replacement. If panel is located towards the front of the cabinet, protective cover will need to extend up and over top of panel.
 - i. Labeling on the Control Panel, Police Panel and Load Bay shall be silk screened on front and back sides. Labeling on Power Panel and all other panels shall be silk screened. Labels shall be legible and shall not be obstructed by cabinet wiring, panels or cables. All labels shall conform to the designations on the cabinet wiring prints. Silk-screening on the backside of the control panel and load bay shall be upside down so that when the panel is opened for maintenance the silk-screening will be right side up.
 - j. The entire load bay shall roll down and provide access to all of the back of panel wiring. All solder terminals shall be accessible when the load-bay is rolled down. The assembly shall be able to roll down without requiring other components, cables or load switches to be removed. The load-bay shall be balanced such that it will not roll down when fully loaded with load switches, flashers and flash transfer relays, when detached from the “C” channel.

The load-bay shall be designed so that all other cabinet screw terminals are accessible without removing cabinet electronics.

Load sockets spaced on 2" center per NEMA TS2 section 5.3.1.2, figure 5-2.

All load switches and flasher shall be supported by a bracket extending at least ½ the length of the load switch.

Load bay shall be mounted on the back wall with 5¾" of clearance to the bottom of the cabinet.

- k. Provide Amphenol MS (military specification) type connectors with cable clamp and sleeve accessories for the 55-pin controller "A" connector, 10-pin controller "A" connector, MMU "A" and "B" connectors and the Power Supply connector. A "shield" ground conductor is required to be externally attached to each connector assembly.
- l. Provide a Marathon part # 1423307 (or equivalent) power distribution blocks for termination of cabinet power feed conductors.

B. Special Features. Provide the following.

Provide a clear plastic cover mounted on top of the detector racks. Clear plastic cover material shall be a minimum thickness of 0.1" Cover to extend over harness connectors and wiring on card slots.

Article 17.6 Operation

- A. The cabinet shall be wired for all red flash operation.
- B. The flashing circuit shall be independent on the controller unit and shall remain in operation upon shutdown of the controller or removal of the controller from the cabinet.
- C. The controller cabinet shall be wired so that removal of the MMU shall cause the intersection to go into flashing operation.
- D. The method by which flashing operation is accomplished shall be determined via program entry and shall be either:
 - 1. Voltage Monitor Output inactive, or
 - 2. Load Switch Driver Output Flashing - Load Switch Driver Output Flashing shall provide an alternating True/False logic output at 1 pulse per second repetition rate with 50 ± 2 percent duty cycle. The selection, via program entry, of Yellow Flashing, Red Flashing, or Dark for each vehicle load switch driver group (G/Y/R) shall be provided. All pedestrian load switch driver groups (W/PC/D) shall be inactive (Dark) in flash.
- E. Pedestrian push buttons shall be operated at 12 VAC.
- F. Controller Priorities. The drives, controls and equipment shall have priorities and each device, control or item of equipment shall override the operation of those items listed below it:
 - 1. Power-Up
 - 2. External Start

3. Preemption
 4. Internal Advance
 5. Stop Time
 6. Automatic Flash
 7. Manual Control Enable
 8. Force Off
- G. Signal Timing Priorities. Patterns and signal plans are capable of being selected on program entry, Interconnect Inputs, Time Base Control events, and a System Interface. The pattern and signal plan select priority shall be as follows:
1. Program Entry
 2. System Interface
 3. Time Base Control Event
 4. Interconnect Inputs

When Time Base Control On-Line is active, the Time Base Control event priority will be lower than the Interconnect Inputs. Should the Sync Monitor diagnostic determine the Interconnect Offset to be invalid, a Time Base Control event may control.

Article 17.7 Shop Tests

Traffic controller cabinet, cabinet wiring diagrams, controller units, and auxiliary equipment shall be shipped to the Traffic Signal Maintenance Lab at 3601 Dr Martin Luther King Jr. Avenue. The Traffic Signal Maintenance personnel shall inspect cabinet wiring, burn in signal cabinet equipment, customize cabinets(s) for desired operation and test in accordance with the following specifications.

The Contractor shall allow six (6) weeks to allow for shop testing. All required equipment including wiring diagrams shall arrive in one shipment. Partial shipments shall not be accepted and will be returned to the vendor.

Traffic signal equipment shall meet the operational and functional requirements of the Drawings and Specifications when tested in accordance with NEMA Standards Publication Number TS2-2003 V2.06, Traffic Controller Assemblies.

If a partial failure occurs at any step in the test physical, environmental, or operational the manufacturer representative shall be permitted to make on site repairs within ten (10) days after notification of the malfunction. The test shall then be restarted at beginning of category in which malfunction occurred. Failure to make repairs in ten (10) days after notification shall result in rejection.

If equipment malfunctions twice in the same category, the equipment shall be rejected. When equipment is rejected, the entire package, including cabinet, will be returned freight collect to the vendor. New equipment, with a different serial number, must then be submitted for testing. Rejected equipment shall not be used on signal projects within the Municipality.

Testing subsequent to rejection of the equipment for failure to comply with specification requirements shall be at the expense of the Contractor. Deductions to cover the costs of such testing shall be made from any monies due or which may come due the Contractor under this Contract.

A failure shall be defined as any occurrence which results in other than normal operation of the equipment. The equipment is considered to have failed if any of the following occur:

1. The controller unit malfunctions.
2. The load switch produces incorrect signal indications.
3. The MMU fails to satisfy the requirements of the Contract Specifications.
4. The detector racks or emergency preemption interface fail to operate correctly.
5. A BIU fails to operate correctly.

After satisfactory completion of the shop test, the Contractor will be notified to pick up the tested and marked equipment at the test site. The Contractor shall pick up successfully tested equipment within two (2) weeks of notification. The Contractor shall deliver said equipment to the Work site. Successful completion of the test does not relieve the Contractor of equipment warranty obligations as specified in Section 80.01, Article 1.4 – Warranties, Guarantees, and Instruction Sheets, or field testing as specified in Section 80.16, Article 16.2 – Field Tests.

Copies of the shop test results shall be sent to the Contractor and associated vendor.

Article 17.8 Installation

- A. Cabinet positioning shall be subject to the review and acceptance of the Traffic Signal Maintenance Foreman.
- B. A three eighths inch (3/8”) fillet of silicone caulking shall be placed between controller cabinet and the concrete foundation to prevent dust and dirt from entering the cabinet.

Article 17.9 Measurement

Traffic signal controllers shall be measured as units, complete and in place, including labor, cabinet, hardware, controller unit, and standard auxiliary equipment, all as required by this Section and by the Contract Drawings Special Provisions to provide a complete and working system.

Traffic monitoring video camera system equipment shall be measured as units complete and in place, including labor, cabinet components, hardware and wiring as required by this Section and by the Contract Drawings to provide a complete working system.

Article 17.10 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
TS2-1 Controller Unit	Each
Traffic Monitor Video Camera System	Each

SECTION 80.18 VEHICLE DETECTORS

Article 18.1 Loop Detectors

For the purpose of this Section, the "home run" and the "home run loop wires" are defined as the pair of wires from the loop in the traveled lane to the nearest junction box. The "lead-in" or "lead-in cable" is defined as the shielded twisted pair cable from the junction box to the controller cabinet.

All connections between the loop wire and shielded lead-in cable shall be made as follows:

- A. Shielded lead-in cable pairs shall not be cut except when they are to be spliced to a loop and then only at the junction box where the splice shall be made. Used and unused ends of the cut pairs should be of equal length.
- B. Place tubular heat shrink insulation over the foil and drain wire on all cut ends of the shielded lead-in cable pairs to ensure drain wire and conductive side of foil are insulated from all other foils and drain wires.
- C. Insert the wires into the appropriately sized end of the Multilink part # ML56-16, or approved equal, splice connector. Crimp and heat the connector in accordance with manufacturer's installation instructions.
- D. Secure cable/conductor bundle with nylon cable ties.
- E. Seal the connection in a splice kit as shown on the detail. All cable and conductor sheaths shall extend a minimum of one inch (1") into re-enterable encapsulating compound. A half inch (1/2") of free space, measured from the outside dimensions of the splice cables/conductors to the inside dimensions of the splice tube kit, shall be left around the circumference and at the ends of all splice cables/conductors. Free space shall be completely filled with approved re-enterable encapsulating compound so that there is no space for water to sit inside of splice kit when kit is stood up vertically.

Testing Requirements:

- A. Continuity Test. The Contractor shall test each loop detector circuit for continuity at the roadside junction box before splicing the loop detector to the lead-in cable. Each loop detector must have a resistance less than 0.5 ohms. After splicing the loop detectors to the lead-in cables, the Contractor shall test each pair at the controller cabinet. Each pair must have a value less than 10 ohms for multipair lead-in cables. The continuity test ohm reading at the cabinet must be greater than the ohm reading measured for the loop detector at the junction box. Where existing lead-in cable is being used, the Contractor shall perform the above test on the lead-in cable prior to splicing with the loop wires. If the tests on the existing lead-in cable are not satisfactory, the Engineer may request that it be replaced and paid per Division 10.
- B. Insulation Resistance (megohm) Test. The Contractor shall complete this test to verify the integrity of each conductor's insulation after pulling the conductors and cables into position and before terminating the conductors. At 500 VDC, each conductor's insulation shall measure a minimum resistance of 100 megohms. With

single conductors, complete the test between each conductor and ground. In each multiconductor cable, complete the test between conductors and between each conductor and ground.

Where existing lead-in cable is being used, the Contractor shall perform the above test on the lead-in cable prior to splicing with the loop wires. If the tests on the existing lead-in cable are not satisfactory, the Engineer may request that it be replaced and paid per Division 10.

All the above tests are to be performed, and the results recorded, by the Contractor in the presence of the Engineer. The Contractor shall supply all the test equipment and deliver signed legible copies of the test reports to the Engineer. The Contractor shall be responsible for correcting any problems found during the loop testing.

Conduit-encased loop wires shall be No. 14 AWG stranded copper wire with PVC tube (IMSA Spec. 51-5).

Each detector loop shall be connected to its own detector lead-in pair of seven (7) pair #18 shielded conductor cable to be used for detector lead-ins. All parallel and series connections shall be made at the cabinet terminal strip.

The upstream and intermediate loop home runs shall be routed to the nearest junction box along a path perpendicular to the direction of travel. Home runs for adjacent loops less than sixteen feet (16') apart shall be routed to the nearest junction box in the same trench to the extent possible to minimize excavation of the pavement.

The stop bar loop home runs will generally be routed to the same junction box. All the home runs shall be routed parallel and adjacent to each other along a path perpendicular to the direction of travel. A path parallel to the direction of travel may be needed from the individual loop to the common perpendicular routing.

Loop locations may be staggered plus or minus six inches ($\pm 6"$) to accommodate home run placement.

The loop and home run conduit shall be one inch (1") PVC Schedule 80 conforming to ASTM D1785. One inch (1") galvanized close nipples and PVC adapters shall be used to connect the PVC conduit to the hot dip galvanized Type X conduit outlet body.

The home run conduit shall be one inch (1") PVC Schedule 80.

If an existing detector loop is indicated in the drawings to have its home run conduit extended to a new location, the same size and type of conduit shall be used for the home run conduit extension.

For installation of loops, loops shall be placed in compacted leveling course bedding material conforming to Division 20, Section 20.22 – Leveling Course. There shall be a minimum thickness of one inch (1") of leveling course beneath the loop conduit and Type X conduit body. A minimum of one inch (1") of compacted leveling course shall be placed on top of the loop conduit and Type X conduit body prior to paving.

Sand bedding shall be non-frost-susceptible, consisting of naturally occurring fine mineral aggregates free of clays, silt, or organic matter.

In constructing conduit encased detector loops, the Contractor shall be responsible for devising his own methods of cutting and restoring the existing asphalt concrete pavement, provided that his methods:

- A. Allow for the maintenance of traffic through the construction zone, and;
- B. When installing loop detectors in existing pavement, cut the asphalt with a saw and remove all asphalt within the saw cut, and;
- C. Replace asphalt concrete in two (2) equal lifts, with a minimum thickness of three inches (3") or the existing pavement thickness, whichever is greater, and;
- D. Reconstruct the base material, including new leveling course and disposal of surplus or unusable material, if necessary, and asphalt concrete, in accordance with Division 20 - Earthwork and Division 40 - Asphalt Surfacing, and;
- E. Are approved by the Engineer.

Full-lane-width asphalt patching is required. Any remaining section less than twelve feet (12') between loops must be replaced to provide a continuous patch. The Contractor shall adhere to the following guidelines:

- A. Where existing pavement will not be overlaid, enclose all loops that enter a common junction box within a trapezoidal saw-cut.
- B. Cut to within one foot (1') of the lane and edge lines, preserving the pavement markings.
- C. Remove the asphalt to the lip of the gutter when there are no edge lines.
- D. Cut across lane lines when loops in adjacent lanes are side by side.
- E. Cut trenches a minimum of three feet (3') wide installing loop tails across a lane.
- F. Trenches crossing a shoulder only may be a minimum of one foot (1') wide.
- G. Contractor shall saw-cut asphaltic concrete pavement for loops in existing pavement.
- H. All existing pavement between detection loops within twelve feet (12') of another loop shall be saw-cut and removed, then repaved continuously.
- I. All traffic markings removed as a result of loop installation in existing pavement shall be replaced to the original alignment and messages.

After the asphalt concrete pavement has been removed according to the Contractor's approved method, the area where the conduit-encased detector loop is to be placed shall be cleared of all rocks and protrusions which may damage the conduit. Sand bedding or leveling course may be required by the Engineer to attain an adequate surface. The Contractor shall take care that the subgrade is not disturbed. If the subgrade material is disturbed, the Contractor shall compact the surface to the satisfaction of the Engineer.

The conduit-encased detector loop shall then be installed and sand bedding or leveling course shall be placed over the loop to a minimum of one inch (1") compacted depth.

An asphalt tack coat per Division 40, Section 40.04 – Tack Coat, shall be applied to all edges of the existing pavement prior to placing new asphalt. Asphalt concrete pavement shall be placed and compacted in a minimum of two (2) equal lifts per Division 40 – Asphalt Surfacing.

When loops are installed in existing pavement or as new Work, traffic shall not be allowed to drive over the loops until the first layer of asphalt has been placed.

Article 18.2 Optical and GPS Detectors - Preemption

Any substitutions of cable, material or equipment in this Article must be submitted to the Municipal Traffic Engineer for testing and approval prior to installation.

Mount detectors according to manufacturer recommendations or as approved by the Engineer. Mount and aim detectors to provide maximum emergency vehicle recognition. Detector locations shown on the Drawings are approximate. Before installing the detectors, gain approval of their final location from the Municipal Traffic Engineer or assigned designee.

Install the following components of the GTT Company's Opticom Priority Control System in accordance with manufacturer's written installation instructions at each signalized intersection listed on the Drawings:

- A. Install the quantity of Model 711, 721, or 722 Optical Detectors on the poles as shown on the Drawings. Mounting hardware shall consist of Pelco Products, Inc. "Astro Mini-Brac" Cable Mount Clamp Kits, or approved equal, and GTT Company "M575 Confirmation Light Hardware" Installation Kit, or approved equal. See Standard Detail 80-55 and Drawings for installation details.
- B. Install Model 138 Optical Detector cable and a three conductor #14 AWG signal cable between each optical detector and the controller cabinet. Furnish enough slack in these cables to leave ten feet (10') of slack in the controller cabinet. Label each cable.
- C. Before attaching the conductors to the optical detector, strip one inch (1") of insulation from the conductors in the Model 138 cable and attach all four (4) conductors to chassis ground in the controller cabinet. Attach the signal cable to the confirmation light. The Traffic Signal Maintenance Shop personnel will make final terminations of the conductors in the controller cabinet.
- D. Install an Opticom Model 3100 GPS/Radio Unit containing a GPS receiver with Antenna and a 2.4 GHz spread transceiver with antenna on the traffic signal pole as shown on the Drawings. Mounting hardware shall consist of Pelco Products, Inc. "Astro Mini Brac" Cable Mount Clamp Kits or approved equal. See Standard Detail 80-55 and Drawings for installation details.
- E. Install a Model 1070 GPS Installation Cable between the Model 3100 GPS Radio Unit and the controller cabinet. Furnish enough cable to reach the top of the controller cabinet and to also leave 10 feet (10') slack in the controller cabinet. Before attaching the conductors to the Model 3100 GPS Radio Unit, strip one inch (1") of insulation from the conductors in the Model 1070 GPS Installation cable and attach all eleven (11) conductors to chassis ground in the controller cabinet. Traffic

Signal Maintenance Shop personnel will make final terminations of the conductors in the controller cabinet.

- F. When retrofitting existing controller cabinets, furnish a Model 764 Phase Selector and a Model 768 Auxiliary Interface Panel for each controller cabinet. Deliver these parts to the Traffic Signal Maintenance Shop Foreman. Parts will be installed in the controller cabinet by Traffic Signal Maintenance personnel. New controller cabinets shall include these parts installed by the controller assembly manufacturer per Section 80.17, Article 17.3 - Standard Auxiliary Equipment.
- G. A manufacturer technical representative shall be available to provide telephonic assist with the physical installation, alignment, and configuration of each supplied Model 3100 GPS Radio Unit. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of the detector unit should such services be required.

Article 18.3 Radar Detectors

Radar Detection System:

Any substitutions of cables, material or equipment in this Article must be submitted to the Municipal Traffic Engineer for testing and approval prior to installation.

System Hardware. For vehicle detection, provide a Wavetronix digital wave radar vision system that consist of the following components:

- A. Stop bar detector (SBD). For all approaches, indicated on the Drawings, provide a Wavetronix SmartSensor Matrix® above-ground stop bar detector (SBD) that will detect all vehicles, including bicycles for reliable and accurate presence detection.
 - 1. Physical Properties. The SBD shall not exceed 5 lbs. in weight. The SBD shall not exceed 14 in. x 12 in. x 4 in. in its physical dimensions. All external parts of the SBD shall be ultraviolet-resistant, corrosion resistant, and protected from fungus growth and moisture deterioration.
 - 2. Enclosure. The SBD shall be enclosed in a Lexan EXL polycarbonate. The enclosure shall be classified "f1" outdoor weather ability in accordance with UL 746C, watertight according to the NEMA 250 Standard, and conform to test criteria set forth in the NEMA 250 standard for type 4X enclosures.
 - 3. Power. The SBD shall consume less than 10 W, operate with a DC input between 9 VDC and 28 VDC, and have an onboard surge protection.
 - 4. Communication. The SBD shall have two half-duplex RS-485 com ports support for dedicated detection comms; and for configuration, verification, or traffic display without disrupting detection comms. The SBD shall support the upload of new firmware into the SBD's non-volatile memory over Ethernet communication port. Both communication ports shall support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200 bps.
 - 5. Operating Conditions. The SBD shall maintain accurate performance in all weather conditions, including: Rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and

dusk. SBD operation shall continue in rain up to 1 in. (2.5 cm) per hour; capable of continuous operation over an ambient temperature range of -40°F to 165°F, and a relative humidity range of 5% to 95% (non-condensing).

6. Testing. Each SBD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator and a FCC certification shall be displayed on an external label on each SBD according to the rules set forth by the FCC. The SBD shall also be tested under IEC 61000-4-5 class 4 and NEMA TS2-2003 Testing. The SBD shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Third party test results shall be made available when requested.
7. Testing. Each SBD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator and a FCC certification shall be displayed on an external label on each SBD according to the rules set forth by the FCC. The SBD shall also be tested under IEC 61000-4-5 class 4 and NEMA TS2-2003 Testing. The SBD shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Third party test results shall be made available when requested.
8. Manufacturing. The SBD shall be manufactured and assembled in the U.S.A.
9. Support. The SBD manufacturer shall provide both training and technical support services.

Training. The manufacturer-provided training shall be sufficient to fully train installers and operators in the installation, auto-configuration, and use of the detector unit to ensure accurate SBD performance.

Technical Assistance. A manufacturer-provided technical representative shall be available to assist with the physical installation, alignment, and configuration of each supplied detector unit. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of the detector unit should such services be required.

10. Documentation. SBD documentation shall include an instructional training guide, a comprehensive user guide, as well as an installer quick-reference guide and a user quick-reference guide. The SBD manufacturer shall supply the following documentation and specification test results at the time of the bid submittal:

- a. FCC CFR 47 certification
- b. IEC 61000-4-5 class 4 test report

9. Warranty. The SBD shall be warranted free from material and workmanship defects for a period of two years from date of shipment.

- B. Continuous tracking advance extended range detector (CTAD). For all eastbound and westbound intersection approaches, provide a CTAD equivalent to the Wavetronix SmartSensor Advance Extended Range® for enhanced dilemma zone detection.

The CTAD shall be able to detect and report information on the roadway located with the near boundary at 50 feet and a far boundary of up to 900 feet from the base of the pole on which the CTAD is mounted.

1. **Physical Properties.** The CTAD shall not exceed 5 lbs. in weight. The CTAD shall not exceed 14 in. x 12 in. x 4 in. in its physical dimensions. All external parts of the CTAD shall be ultraviolet-resistant, corrosion resistant, and protected from fungus growth and moisture deterioration.
2. **Enclosure.** The CTAD shall be enclosed in a Lexan EXL polycarbonate. The enclosure shall be classified "f1" outdoor weather ability in accordance with UL 746C, watertight according to the NEMA 250 Standard, and conform to test criteria set forth in the NEMA 250 standard for type 4X enclosures.
3. **Power.** The CTAD shall consume less than 8 W, operate with a DC input between 12 VDC and 28 VDC, and have an onboard surge protection.
4. **Communication.** The CTAD shall have two serial communication ports, and both ports shall communicate independently and simultaneously. The CTAD shall support the upload of new firmware into the CTAD's non-volatile memory over Ethernet communication port. Both communication ports shall support all of the following baud rates: 9600, 19200, 38400, 57600, and 115200 bps.
5. **Windows Mobile®-based Software.** The CTAD shall include graphical user interface software that displays the current traffic pattern using a graphical traffic representation.
 - a. The graphical user interface shall also display all configured alerts and provide visual representation of their actuation.
 - b. The graphical user interface shall provide a means of logging the vehicular track files with an update rate of greater than five times per second.
 - c. The graphical interface shall operate on Windows Mobile, Windows 2000, Windows XP and Windows Vista in the .NET framework.
 - d. The software shall support the following functionality:
 - i. Automatically find the correct baud rate
 - ii. Automatically find the correct serial communication port
 - iii. Operate over a TCP/IP connection
 - iv. Provide a virtual sensor connection for software usability without a sensor
 - v. Give the operator the ability to save/back up the CTAD configuration to a file or load/restore the CTAD configuration from a file
6. **Operating Conditions.** The CTAD shall maintain accurate performance in all weather conditions, including: Rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk. CTAD operation shall continue in rain up to 1 inch per hour; capable of

continuous operation over an ambient temperature range of -40°F to 165°F, and a relative humidity range of 5% to 95% (non-condensing).

7. Testing. Each CTAD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator and a FCC certification shall be displayed on an external label on each CTAD according to the rules set forth by the FCC. The CTAD shall also be tested under IEC 61000-4-5 class 4 and NEMA TS2-2003 Testing. The CTAD shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Third party test results shall be made available when requested.
8. Manufacturing. The CTAD shall be manufactured and assembled in the U.S.A.
9. Support. The CTAD manufacturer shall provide both training and technical support services.

Training. The manufacturer-provided training shall be sufficient to fully train installers and operators in the installation, auto-configuration, and use of the detector unit to ensure accurate CTAD performance.

Technical Assistance. A manufacturer-provided technical representative shall be available to assist with the physical installation, alignment, and configuration of each supplied detector unit. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of the detector unit should such services be required.

10. Documentation. Documentation shall include an instructional training guide, a comprehensive user guide, as well as an installer quick-reference guide and a user quick-reference guide. The manufacturer shall supply the following documentation and specification test results at the time of the bid submittal:

FCC CFR 47 certification

IEC 61000-4-5 class 4 test report

- C. Click! Cabinet interface device (CIB). For each signal cabinet, as indicated in the Drawings, provide a Click! cabinet interface device that will provide a streamlined communication for SmartSensor Matrix, Smartsensor Advance, and Smartsensor Advance Extended Range to traffic controllers in one compact case. This module communicates directly to the controller through SDLC and supports contact closure devices as well. It also provides power, surge protection, and Ethernet connectivity for all sensors.

1. Included components.
 - a. Click! CIB, AC power cord, Extra fuse, Terminal blocks for attaching to cable, and 4 jumper cables
2. Physical.
 - a. Weight: 4.9 lbs.
 - b. Physical dimensions: 7.8 in. × 10.3 in. × 3.9 in.
 - c. Ambient operating temp: -29°F to 165°F

- d. Humidity: up to 95% RH
- 3. Mounting.
 - a. Shelf-mount
- 4. Power.
 - a. Power supply voltage: 90 to 260 VAC
 - b. AC frequency: 50–60 Hz
 - c. Max power: 75 W @ 80°C
 - d. 24 VDC output on sensor connectors
- 5. Connections and Communications.
 - a. One RJ-45 10/100 Ethernet jack
 - b. One SDLC port
 - c. Four terminal block connectors on back of device for connecting to sensors
 - d. Four RJ-11 jacks on faceplate of device for connecting to contact closure devices
 - e. Four communication ports on faceplate
 - DB-9 port for communicating via RS-232
 - Two RJ-11 jacks for communicating via RS-485
 - USB mini-B connector
 - T-bus port
- 6. Testing.
 - a. Complies with the applicable standards stated in the NEMA TS2- 2003 Standard
 - b. FCC-compliant
 - c. Passes manufacturer’s test before shipping
- 7. Warranty.
 - a. Two-year warranty against material and workmanship defect
- D. SmartSensor Manager Matrix (SSMM) software
- E. SmartSensor Mount
 - 1. Provide a Wavetronix SmartSensor mounting assembly.
 - 2. The mounting assembly shall provide at least two axes of rotation to ensure proper installation.
 - a. The mounting assembly shall be able to support at least a 15-lb. load.

- b. The mounting assembly shall feature a symmetric hole pattern that mates with fixed and rotational SmartSensor back plates.
 - c. The mounting assembly shall have two contact points with the pole.
 - d. The mounting assembly shall be slotted for 3/4" banding.
3. The mounting assembly shall be constructed of 0.1875" thick or thicker aluminum with 316 stainless steel hardware. The mounting assembly shall be powder coated for oxidation resistance.
- F. Installation Kit. Provide a Wavetronix Install Kit, for use while installing and configuring Wavetronix SmartSensor products, and communication connectivity devices to the Wavetronix Click! products.
- G. Smartsensor Cable Junction Box. For each radar sensor, provide a Wavetronix in-line terminal strip junction box enclosure to connect the Wavetronix 6-conductor pigtail cable to the APT Matrix 2 homerun cable. Enclosure shall readily fit inside the signal pole base via the pole base handhole. Enclosure to meet IP 66 and NEMA 4X ratings.
- H. Wavetronix SmartSensor 6-conductor cable. For each Wavetronix SmartSensor Matrix® above-ground stop bar detector (SBD) indicated in the Drawings provide a cable of the length indicated in the Drawings. Cable to run from the detector to an in-line terminal strip enclosure at the pole base handhole.
- I. Wavetronix SmartSensor Matrix Type 2 Home Run cable. For each Wavetronix SmartSensor Matrix® above-ground stop bar detector (SBD) indicated in the Drawings provide a cable of the length to run from the in-line terminal strip enclosure at the pole base handhole to the Click! device unit inside the controller cabinet. Provide 15' of neatly coiled slack cable in the base of the controller foundation
- J. Wavetronix SmartSensor 6-port SDLC interface panel. For each signal cabinet, indicated in the Drawings, provide a 6-port SDLC interface panel (WS-SDLC-IP6), a 3' SDLC cable (WS-SDLC-TS2-3) and 7' SDLC cable (WS-SDLC-TS2-7) to provide data communication between the new radar detection and existing controller and controller cabinet equipment.

Article 18.4 Ultrasonic Detectors - Ultrasonic Presence Sensors

Ultrasonic Detectors shall not be used without prior approval of the Municipal Traffic Engineer.

Article 18.5 Video Detectors

Video Detectors shall not be used without prior approval of the Municipal Traffic Engineer.

Article 18.6 Measurement

Loop detectors shall be measured as units, complete and in place, including all labor, equipment, specified materials and miscellaneous materials to provide a complete and functioning unit, including the home run to the nearest junction box. Bid item "Install Loop Detectors in Existing Pavement" includes, but is not limited to, all costs of cutting

and restoring existing pavement; excavation; disposal of surplus or unusable material; and placement of leveling course.

Optical and GPS preemption detectors, radar detectors and ultrasonic detectors shall be measured as units, complete and in place, including all labor, equipment, specified materials and miscellaneous materials to provide a complete and functioning unit, including all cabinet assembly and all hardware installed in the cabinet. Radar detector item shall include the 6-conductor cable between the detector and the junction box located inside the pole.

Article 18.7 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07, Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Install Loop Detector - New Work	Each
Install Loop Detector - Existing Pavement	Each
Install Optical and GPS Preemption Detector (Type)	Each
Install Radar Detector	Each
Install Ultrasonic Detector	Each
Install Video Detectors	Each

SECTION 80.19 VEHICLE SIGNAL HEADS

Article 19.1 General

LED Signal Heads shall conform to the following publications:

- A. Circular Indications: Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement, 6/27/05 (ITE Publication ST-052). This is hereafter referred to as "VTCSH-05".
- B. Arrow Indications: Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement 7/1/07 (ITE Publication ST-054). This is hereafter referred to as "VTCSH-Arrow-07."

Each signal head shall be adjustable, vertical type with the number and type of sections as specified herein and shown on the Drawings; shall provide an indication in one direction only; shall be adjustable through 360 degrees about a vertical axis; and shall be mounted at the location and in the manner shown on the Drawings.

Vehicle Signal Heads shall have Light Emitting Diode (LED) lamps for all red, green and yellow indications. Red, green and yellow lamps shall conform to Article 19.4 – Light Emitting Diode (LED) Optical Units.

Each lens shall be provided with a removable tunnel visor, with an open slot at the bottom. The visor shall be constructed of aluminum. Visors shall be painted as specified in Section 80.16, Article 16.4 – Painting for Structures.

Vehicle signal housings shall conform to the following:

- 1. All parts of the housing, including the doors and end plates, shall be of die cast aluminum conforming to the specifications of ASTM B85, and all parts shall be clean, smooth, and free from flaws, cracks, blow holes, or other imperfections, unless otherwise called for on the Drawings.
- 2. The housing of each signal section shall be one piece with integral top, bottom, and sides, with square doors.
- 3. All exposed bolts, screws, hinges pins, and door locking devices shall be stainless steel. All interior screws and fittings shall be stainless steel or approved non-ferrous, corrosion-resistant material.
- 4. The top and bottom of each housing shall have an opening to accommodate standard one and one-half inch (1-1/2") pipe fittings and brackets.
- 5. The top and bottom opening of the housing shall have an integral serrated boss that will provide positive positioning of the signal head in five (5) degree increments to eliminate undesirable rotation or misalignment of the signal head as well as between sections. A total of seventy-two (72) teeth shall be provided in the serrated boss. The teeth shall be clean and sharp to provide positive positioning with the grooves of the mating section or framework.
- 6. Individual signal sections shall be fastened together with a cadmium-plated tri-stud connector, lock washers, and nuts with access holes for the passage of electrical conductors from one section to another.

7. Each signal housing shall have two (2) integral hinge lugs located on the left side for mounting the door.
8. Eight inch (8") signal heads shall have one (1) latch and twelve inch (12") signal heads shall have two (2) latches. Latches shall be provided on the right side of each signal housing with stainless steel wing nut assemblies for the purpose of engaging the door latches.
9. Each signal housing shall have a door opening for the periphery which shall have a soft, closed-cell neoprene gasket to provide a weather-tight seal with the mating door.
10. The door of each signal housing shall be provided with a round opening designed to accommodate any standard traffic signal lens.
11. Signal housings shall be painted as specified in Section 80.16, Article 16.4 – Painting for Structures.
12. The top of the signal housing shall be manufactured to shed water. Cast ribs shall be tapered and notch(s) cast in the top back section of the housing to drain water off the signal housing.
13. Housing shall be manufactured so that the surface contact area at each attachment point of the backplate to the signal housing shall be a minimum of 1.5 square inches. The shortest dimension of the contact area shall not be less than 0.75 inches. An attachment location is required at each corner of the signal section housing.

Article 19.2 Installation

- A. Vehicle signal heads shall not be installed at any intersection until all other signal equipment, including the controller, is in place and ready for operation at that intersection, unless the faces are not directed toward traffic or unless the faces are adequately covered. Contractor shall cover heads with beige colored canvas shirts sized to fit the signal faces shown in the Drawings. Each shirt shall feature elasticized openings that fit over the visors and at least two straps to secure it to the signal. Provide shirts with a legend that reads "out of service" and a center section that allows an operator to see the indications during system tests.
- B. Vehicle signal head mounting hardware shall be attached to the side of pole that faces away from traffic unless otherwise approved by the Municipal Traffic Engineer.
- C. All conductor access holes drilled for side mounted vehicular signal heads shall be deburred inside and out to prevent scraping of the conductors. The holes shall be cleaned and painted with two (2) coats of zinc chromate primer for metal.
- D. Through phase vehicle signal faces shall be aimed at a point located a distance from the face as shown in the following table. If two (2) through signal faces are not visible from this point at an eye height of three and one-half feet (3.5') above finished grade, then the Municipal Traffic Engineer shall be consulted for corrective measures.

Signal Head Visibility Distances

Posted Speed Limit (mph)	Minimum Visibility Distance (ft.)
20	328
25	394
30	460
35	540
40	390
45	624
50	722
55	820
60	902

- E. Backplates shall be attached to the signal head using plated steel rivets with large flange button heads. The rivet shall be two-tenths inches (0.2") in diameter and 0.575 inches long and at least 2380 N and 3000 N shear and tensile strength, respectively. Bore out the mounting holes in the backplates and signal heads to the diameter recommended by the rivet manufacturer.
- F. Each lens shall be provided with a removable tunnel visor, with an open slot at the bottom, constructed of aluminum and securely installed using machine screws. The threads of the machine screws shall be coated with an antiseizing compound before installation.
- G. Removal and relocation of existing signal heads, as shown on the Drawings, shall utilize new mounting hardware.
- H. When installing LED signal heads, the Contractor shall clearly and permanently mark the date installed on the back of each LED signal module.

Article 19.3 Signal Head Mounting

Mast arm mounted signal head locations shown on the Drawings are approximate. Signal heads shall be installed over lane lines or over the center of lanes, as shown on the Drawings. Mounting locations shall be verified using the as-built lane markings and signal pole foundation location. Obtain the approval of the Engineer before wire access holes are drilled in mast arms.

A. Mast Arm Signals

Signal head assembly for suspension from mast arm shall be equipped with a bronze plumbizer.

All holes in mast arms shall be field drilled to ensure proper location of signal heads with respect to traffic lanes. Arms shall be drilled for wire accesses after installation on the base of the pole. The wire hole locations shall be directly centered on the mounting bracket on the signal head side of the mast arm.

All mast arm mounted signal heads shall be mounted using "Astro-Brac" band mount clamp kits part number AB-3035-SS-L (with stainless upgrade option), brackets manufactured by Pelco Products Inc., or an approved substitute. The mounting nipple shall be a two inch (2") rigid metal conduit, cut to a length of six inches (6"). The mounting nipple shall have one inch (1") of tapered thread on

one end, be drilled to accept the plumbizer through bolt and all openings shall be deburred.

B. Pole and Post Mounted Signals

Bracket mounted signal heads, as shown on the Drawings, shall be supported by mounting brackets consisting of watertight assemblies of one and one-half inch (1 1/2") standard steel pipe and malleable iron or brass pipe fittings. All members shall be either plumb or level, symmetrically arranged, and securely assembled. Construction shall be such that all conductors are concealed within the assembly.

The horizontal nipples shall be of adequate length to achieve the required offsets indicated on Standard Details 80-27 and 80-29. Offsets are calculated from center of signal head mounting opening to center of vertical riser on terminal compartments. Side mounted frames twenty-two inches (22"), double head post top mount eleven inches (11"), and single head post top mount six inches (6").

Where four (4) or five (5) section vertical signal heads are side mounted on poles, a steel conduit hanger shall be installed on the vertical framework pipe, six inches (6") down from the upper horizontal framework pipe. A conduit hanger shall be mounted to the pole with a five-sixteenth inch (5/16") bolt and lock washer.

Pole side mounted traffic signal heads shall be mounted on the back side of pole unless noted or detailed otherwise on the Drawings. The pole/post-mounted traffic signal heads shall be mounted so that no portion of the backplates are hidden by the pole/post.

At each signal location, unless otherwise shown on the Drawings, a terminal compartment shall be constructed into the mounting brackets.

For post-top mounting of bracket mounted signals, the terminal compartment shall be cast with an integral slip-fitter.

For post-top mounting of a one-way signal head, a slip-fitter without a terminal compartment may be used.

Post-top signal heads with backplates shall be mounted with an offset slip-fitter to allow the signal head backplate to clear the signal pole.

Attach each side mounted terminal compartment with two (2) one-half inch (1/2") - 13 stainless steel cylindrical socket head bolts with washers, threaded into holes tapped into the side of the pole.

C. Programmed Visibility Traffic Signal Heads

The Contractor shall program the head as recommended by the manufacturer and as directed.

When programmed, each signal face's indication shall be visible only in those areas or lanes to be controlled, except that during dusk and darkness a faint glow to each side shall be permissible.

Article 19.4 Light Emitting Diode (LED) Optical Units

All LED vehicle lamps shall be GELcore, Dialight or an approved equal. Any substitutions must be submitted to the Municipal Traffic Engineer for testing and approval prior to bid award. LED vehicle lamps shall meet the following specifications:

A. Definition

1. Eight inch (8") and twelve inch (12") indications for all vehicle traffic signals faces shall utilize light emitting diode signal modules.
2. Light emitting diode (LED) signal modules shall consist of an assembly that utilizes light emitting diodes as the light source in lieu of an incandescent lamp for use in traffic signal sections.

B. General

1. LED signal modules shall be designed to be installed in the doorframe of a standard traffic signal housing. The lamp socket, reflector, reflector holder and lens used with an incandescent lamp shall not be used in a signal section in which an LED signal module is installed.
2. LED signal modules shall be a sealed unit with two (2) conductors for connecting to power, a printed circuit board, power supply, a lens and gasket, and shall be weatherproof after installation and connection. The circuit board and power supply shall be contained inside the module.
3. Conductors for modules shall be forty inches (40") in length, with insulated quick disconnect terminals.
4. The lens of the module shall be integral to the unit, shall be convex with a smooth outer surface and made of ultraviolet stabilized plastic or of glass. The lens shall be capable of withstanding ultraviolet (direct sunlight) exposure for a minimum period of five (5) years without exhibiting evidence of deterioration.
5. The module shall be sealed in the door frame with a one-piece EPDM (ethylene propylene rubber) gasket.
6. The LEDs shall utilize AlInGaP technology and shall be the ultra bright type rated for 100,000 hours of continuous operation from 40°F to 165°F (40°C to 74°C). AlGaS LEDs shall not be allowed.
7. The failure of an individual LED in a string shall only result in the loss of that LED, not the entire string or indication.
8. Furnish LED signal modules rated for a minimum useful life of sixty (60) months and that meet current ITE Standards for LED signal modules.

C. Physical and Mechanical Requirements

1. LED traffic signal modules shall be designed as retrofit replacements for existing optical units of signal lamps and shall not require special tools for installation. LED signal modules shall fit into existing traffic signal section housings built to the VTCSH standard without modification to the housing.

2. Installation of an LED signal module shall only require the removal of the optical unit components, i.e., lens, lamp module, gaskets, and reflector; shall be weather tight and fit securely in the housing; and shall connect directly to electrical wiring.

LED Signal Module Lens. The LED signal module shall be capable of replacing the optical unit. The lens may be tinted or may use transparent film or materials with similar characteristics to enhance ON/OFF contrasts. The use of tinting or other materials to enhance ON/OFF contrasts shall not affect chromaticity and shall be uniform across the face of the lens.

Use only clear lenses for all green signal modules.

If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance.

Environmental Requirements. The LED signal module shall be rated for use in the operating temperature range of -40°F to 165°F (-40°C to 74°C).

The LED signal module shall be protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal components.

The LED signal module lens shall be UV stabilized.

Construction. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The power supply for the LED signal module shall be integral to the unit.

Module Identification. Each LED signal module shall have the manufacturer's name, trademark, and other necessary identification permanently marked on the back of the module. Each individual LED signal module shall be identified for warranty purposes.

The following operating characteristics shall be identified: rated voltage, power consumption, and volt-ampere.

Each LED signal module shall have prominent and permanent vertical marking(s) for correct indexing and orientation within signal housing. The markings shall consist of an up arrow, or the word "UP" or "TOP."

D. Photometric Requirements

1. LED traffic signal modules shall meet at least eighty-five percent (85%) of the minimum VTCSH intensity requirements while operating throughout the operating temperature range of -40°F to 165°F (-40°C to 74°C).
2. The minimum initial luminous intensity values for LED traffic signal modules shall be as defined in Section 11.04 of the VTCSH standard at 77°F (25°C).
3. The measured chromaticity coordinates of LED signal modules shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the VTCSH standard.

E. Electrical

1. LED signal modules shall operate from a sixty-hertz (60 Hz) ± 3 Hz AC line over a voltage ranging from eighty (80) volts to one hundred thirty-five (135) volts. The LED circuitry shall prevent perceptible flicker over the voltage range specified above. The fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications. Rated voltage for all measurements shall be one hundred twenty (120) volts. The LED traffic signal lamp unit shall not be capable of functioning at less than forty-five (45) volts.
2. All wiring and terminal blocks shall meet the requirements of Section 13.02 of the VTCSH standard. Two (2) secured, color-coded, 1 m long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electric Code, rated for service at 221°F (+105°C), are to be provided for electrical connection for each LED signal module.
3. The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of NEMA Standard TS-2, 1992.
4. LED signal modules shall be operationally compatible with currently used controller assemblies (solid state load switches, flashers, and conflict monitors).
5. LED signal modules and associated on-board circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
6. The LED signal module shall provide a power factor of nine-tenths (0.90) or greater.
7. Total harmonic distortion (current and voltage) induced into an AC power line by a LED signal module shall not exceed twenty percent (20%).

F. Production Testing Requirements

1. Each new LED traffic signal lamp unit shall be energized for a minimum of twenty-four (24) hours at operating voltage and at a temperature of 140°F (60°C) in order to cause any electronic infant mortality to occur, and to ensure electronic component reliability prior to shipment.
2. After the burn-in procedure is completed, each LED traffic signal lamp unit shall be tested by the manufacturer for rated initial intensity at rated operating voltage.

G. Warranty

The manufacturer shall provide a written warranty against defects in materials and workmanship for the LED signal modules for a period of sixty (60) months after installation of the modules. Replacement modules shall be provided promptly after receipt of modules that have failed at no cost to the Owner except cost of shipping of the failed modules. Provide the Engineer with all warranty documentation prior to installation. Deliver the replacement modules to Traffic Signal Maintenance

Shop within five (5) working days of notification. The warranty does not include the costs associated with removing and reinstalling units that are replaced or repaired.

Article 19.5 Backplates

Backplates shall be furnished and attached to all vehicle signal heads, including programmed visibility signal heads, except for post mounted flashers which shall be installed without backplates.

Backplates shall be constructed of 0.063-inch minimum thickness aluminum alloy sheet meeting ASTM B 209, alloy 3003-H14. All backplates shall be five inch (5") wide. For backplates consisting of two (2) or more sections, they shall be fastened together with 3/16" aluminum rivets or bolts peened after assembly.

Backplates shall be painted as specified in Section 80.16, Article 16.4 – Painting for Structures.

Article 19.6 Signal Head Mounting Hardware

A signal head assembly for suspension from mast arm shall be equipped with a bronze plumbizer. Replace manufacturer supplied set screws with three-eighth inch (3/8") – 16 by one and one quarter inch (1-1/4") stainless steel hex bolts.

All mast arm mounted signal heads shall be mounted using "Astro-Brac" band mount clamp kits part number AB-3035-SS-L (with stainless upgrade option) brackets manufactured by Pelco Products, Inc., or an approved substitute. The mounting nipple shall be a two inch (2") rigid metal conduit, cut to a length of six inches (6"). The mounting nipple shall have one inch (1") of tapered thread on one end, be drilled to accept the plumbizer through bolt, and all openings shall be deburred.

A. Pipe and Fittings

Bracket mounting hardware shall be one and one-half inch (1 1/2") standard steel pipe and malleable iron or brass pipefittings. Construction shall be such that all conductors are concealed within a watertight assembly.

Signal heads shall be equipped with positive brass lock rings and fittings designed to prevent heads from turning due to external forces. Lock ring and connecting fittings shall have serrated contacts.

B. Terminal Compartment

Terminal compartments shall be bronze of sufficient strength to remain intact in event the pole is knocked down.

For post-top mounting of bracket mounted signals, the terminal compartment shall be cast with an integral slip-fitter. Each terminal compartment shall be fitted with a terminal block containing twelve (12) poles, each with two (2) screw type terminals. Each terminal shall accommodate at least three (3) No. 14 AWG conductors. A raintight cover shall be provided, giving ready access to the terminal block.

C. Slip-fitters

Slip-fitter shall fit over a four inch (4") standard pipe or four and one-half inch (4 1/2") outside diameter end of tapered standard. Each slip-fitter shall be provided with two (2) rows of steel set screws, with three (3) screws in each row to secure

the assembly in plumb position. Set screws shall be cadmium plated. Replace manufacturer supplied set screws with 3/8"-16 x 1 1/4" stainless steel hex bolts.

Slip-fitters, where used without integral terminal compartment, shall be of cast-iron.

Post-top signal heads with backplates shall be mounted with an offset slip-fitter to allow the signal head backplate to clear the signal pole.

D. Painting

Mounting brackets and fittings shall be painted as specified in Section 80.16, Article 16.4 – Painting for Steel Structures.

Article 19.7 Programmed Visibility Traffic Signal Heads

Each programmed visibility signal face and the installation thereof shall conform to the provisions of Article 19.1 - General; Article 19.2 - Installation; Article 19.3 - Signal Head Mounting; and Article 19.7 - Signal Head Mounting Hardware, except as modified in this subsection.

Each programmed visibility signal section shall provide a nominal twelve inch (12") diameter circular or arrow indication. Color and arrow configuration shall conform to the latest I.T.E. Specification.

Each section shall be provided with a sun visor.

Each signal section shall be provided with an adjustable connection that permits incremental tilting from zero (0) to ten (10) degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting axis in five (5) degree increments.

The signal shall be mountable with ordinary tools and capable of being serviced without tools. Adjustment shall be preset at four (4) degrees below the horizontal, unless otherwise specified.

The visibility of each programmed visibility signal face shall be capable of adjustment or programming within the face. When programmed, each signal face's indication shall be visible only in those areas or lanes to be controlled, except that during dusk and darkness a faint glow to each side shall be permissible.

Prior to programming, each signal section with a yellow indication shall provide a minimum luminous intensity of three thousand (3,000) candela on the optical axis, and a maximum intensity of thirty (30) candela at fifteen (15) degrees horizontal from the axis. Each such signal section shall be capable of having its visibility programmed to achieve the following luminous intensities: a minimum of 3,000 candela on the optical axis, a maximum of one hundred (100) candela at from one-half (1/2) to two (2) degrees horizontal from the axis and a maximum of ten (10) candela at from two (2) to fifteen (15) degrees horizontal from the axis. Under the same conditions, the intensities of the red indication and the green indication shall be at least nineteen percent (19%) and thirty eight percent (38%) respectively of the yellow indication.

Each signal face or each signal section shall include integral means for regulating its luminous intensity between limits in proportion to the individual background luminance. Lamp intensity shall not be less than ninety-seven percent (97%) of uncontrolled intensity at 1000 foot-candles, and shall reduce to 15±two percent of maximum intensity at less than one foot-candle. The dimming device shall operate over an applied voltage

range of ninety-five (95) to one hundred thirty (130) volts, sixty hertz (60 Hz) and a temperature range of -40°C to 74°C.

The Contractor shall supply the material required for programming of the head. The programming of the head shall be accomplished by the Traffic Signal Maintenance Shop.

Article 19.8 Measurement

New and relocated signal heads shall be measured as units, complete and in place, including all labor, mounting hardware, equipment and materials to provide a complete and functioning unit. Measurement shall be for the actual number of existing signal heads removed and relocated, and the actual number of new signal heads having the specified number of indicators of the specified size. Left arrow, right arrow, and round ball faces of the same size shall be considered identical pay items.

Article 19.9 Basis of Payment

Payment for this work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall be full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
(3, 4, 5) Face Signal Head	Each
Remove and Relocate Existing Signal Head	Each

SECTION 80.20 PEDESTRIAN SIGNALS

Article 20.1 General

Pedestrian signals shall be the Light Emitting Diode (LED) Type.

Pedestrian signals shall show the following:

1. Steady "WALKING PERSON" during the pedestrian interval.
2. Flashing "HAND" and countdown time "XX" in seconds during the pedestrian clearance interval.
3. Steady "HAND" after the pedestrian clearance and during the associated phases yellow and all red vehicle clearance intervals.
4. Dark during intersection flash.

Pedestrian signal mounts shall be two-piece hinge connected type (clamshell) unless otherwise shown on the Drawings.

Conductors shall be #14 AWG or larger conforming to IMSA Specification 20-1.

Article 20.2 Installation

Pedestrian signal heads shall be directed at the center of the crosswalk on the opposite side of the street.

Pedestrian signal heads shall not be installed at any intersection until all other signal equipment, including the controller, is in place and ready for operation at that intersection, unless the faces are not directed toward traffic or unless the faces are adequately covered. Contractor shall cover heads with beige colored canvas shirts sized to fit the signal faces shown in the Drawings. Each shirt shall feature elasticized openings that fit over the visors and at least two straps to secure it to the signal. Provide shirts with a legend that reads "out of service" and a center section that allows an operator to see the indications during system tests.

Pedestrian signal head mounting hardware shall be attached to the side of pole that faces away from traffic unless otherwise approved by the Municipal Traffic Engineer.

All conductor access holes drilled for side mounted pedestrian heads shall be deburred inside and out to prevent scraping of the conductors. The holes shall be cleaned and painted with two (2) coats of zinc chromate primer for metal.

Removal and relocation of existing signal heads, as shown on the Drawings, shall utilize new mounting hardware.

When installing LED signal heads, the Contractor shall clearly and permanently mark the date installed on the back of each LED signal module.

Article 20.3 Mounting

Side mounted pedestrian signal hardware shall consist of a two-piece, hinge connected, cast aluminum bracket that mounts directly between the pole and the side of the signal head housing. The two-piece bracket shall be designed to swing open a minimum of 135 degrees. Clearance between the head and pole shall not exceed three inches (3"). The bracket shall properly fit any round pole four inches (4") or greater in diameter and

be capable of being rotated a minimum of thirty (30) degrees when mounted on a four inch (4") pole. A raintight, three (3) position terminal block shall be contained within the mounting bracket.

Mounting brackets and fittings shall be painted as specified in Section 80.16, Article 16.4 – Painting for Structures.

Attach each clamshell bracket with two (2) three-eighth inch (3/8") – 16 stainless steel cylindrical socket head bolts with washers, threaded into holes tapped into the side of the pole.

Article 20.4 Housing

- A. The case shall be a one-piece, corrosion-resistant, aluminum-alloy die-casting complete with integrally cast top, bottom, sides and back. Four (4) integrally cast hinge lug pairs, two (2) at the top and two (2) at the bottom of each case, shall be provided for operation of a swing-down door.
- B. The case for pedestrian signals shall be dustproof, weatherproof, corrosion resistant, and shall provide for easy access to, and replacement of, all components.
- C. Two (2) versions of the case shall be available. The first version shall be supplied with clamshell mounting hardware installed (ordered concurrently) for installation of "pole left of message." The second version shall be the "pole right of message." Openings in the top and bottom of the housing are not allowed.
- D. The door frame shall be a one-piece, corrosion-resistant, aluminum-alloy die-casting, complete with two (2) hinge lugs cast at the bottom and two (2) latch lots cast at the top of each door. The door shall be attached to the case by means of two (2) Type 304 stainless steel spring pins. Two (2) stainless steel hinged bolts with captive stainless steel wingnuts and washers shall be attached to the case with the use of stainless steel spring pins. Hence, latching or unlatching of the door shall require no tools.
- E. "Z-crate" or "Egg-crate" type filters shall not be used.
- F. All machine screws, studs and washers shall be stainless steel.
- G. Gaskets shall conform to the provisions in ASTM D-1056, Grade RE 42.
- H. The outside of the housing shall be painted in accordance with the provisions of Section 80.16, Article 16.4 – Painting for Structures.
- I. The housings shall accept a sixteen inch by eighteen inch (16" x 18") pedestrian module.
- J. If pedestrian signal head visors are indicated on the Drawings, provide visors that are constructed of aluminum. Visors shall be three sided with the bottom side being open. Visors shall be painted as specified in Section 80.16, Article 16.4 – Painting for Structures.

Article 20.5 Light Emitting Diode (LED) Pedestrian Signal Modules

A. General

LED traffic signal modules shall meet the current ITE standards.

B. Installation

1. LED pedestrian signal modules shall be designed as retrofit replacements for the existing pedestrian signals (ICC 4090 and/or 4094).
2. LED pedestrian signal modules shall not require special tools for installation.
3. LED pedestrian signal modules shall fit into the existing traffic housings built to the PTCSI standard without any modification to the housing.
4. LED pedestrian signal modules shall be weathertight, fit securely in the housing and shall connect directly to existing electrical wiring.
5. Installation of a replacement LED module into the existing pedestrian housing shall only require removal of the existing optical unit components, i.e., lens, lamp, gaskets, and reflector.
6. Each retrofit shall include all necessary components to complete conversion, including a one-piece gasket.
7. Each pedestrian module shall have a sticker attached stating compliance to the ITE standard for color.

C. LED Signal Lens

1. The lens of the LED pedestrian signal modules shall be field replaceable.
2. The lens of the LED pedestrian signal modules shall be polycarbonate UV stabilized and a minimum of six millimeters (6 mm) thick.
3. The exterior of the lens of the LED pedestrian signal module shall be smooth and frosted to prevent sun phantom.

D. LED Pedestrian Signal Module Construction

1. The LED pedestrian signal module shall be a single, self-contained device, not requiring on-site assembly for installation in the existing traffic signal housing.
2. All Portland Orange LEDs shall be "AllnGaP" technology or equal, and rated for 100,000 hours or more at +165°F (+25°C) and twenty milliamps (20 mA). "AllnGaS" technology is not acceptable.
3. Each individual LED traffic module shall be identified for warranty purposes with the manufacturer's trade name, serial number and operating characteristics, i.e., rated voltage, power consumption, and volt-ampere.

E. Environmental Requirements

1. The LED pedestrian signal modules shall be rated for use in the ambient operating temperature range of -40°F to +140°F (-40°C to +60°C).

2. The LED pedestrian signal modules, when properly installed with gasket, shall be protected against dust and moisture intrusion per requirements of MIL-STD-810F Procedure 1, Rain and Blowing Rain.

F. Luminous Intensity

1. Pedestrian LED signal modules shall be designed so, that when operated over the specified ambient temperature and voltage range, the signal shall attract the attention of, and be readable to, a viewer (both day and night) at all distances from ten feet (10') to the full width of the area to be crossed.
2. The luminous intensity of the LED pedestrian signal module shall not vary more than $\pm 10\%$ for voltage range of 80 VAC to 135 VAC.

G. Chromacity

The measured chromaticity coordinates of the LED signal modules shall conform to the chromaticity requirements of Section 5.3 and Figure C of PTCSI standard.

H. Electrical

1. The secured, color-coded, one meter (1 m) long, 600V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at $+221^{\circ}\text{F}$ ($+105^{\circ}\text{C}$), twelve millimeter (12 mm) stripped and tinned are to be provided for electrical connection.
2. The LED pedestrian signal module shall operate from a $60 \pm 3\text{Hz}$ AC line over a voltage range of 80 VAC to 135 VAC. Rated voltage for all measurements shall be 120 ± 3 volts rms.
3. The LED circuitry shall prevent perceptible flicker over the voltage range specified above.
4. The LED pedestrian signal module circuitry shall include voltage surge protection against high-repetition noise transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992.
5. Catastrophic failure of one LED light source shall not result in the loss of more than the light from that one LED.
6. The LED pedestrian module shall be operationally compatible with the currently used controller assemblies. The LED pedestrian module shall be operationally compatible with conflict monitors.
7. The LED pedestrian module including its circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of noise.
8. The LED pedestrian module shall provide a power factor of 0.90 or greater over the operating voltage range and temperature range specified above for modules with six (6) watts or more.
9. Total harmonic distortion (current and voltage) induced into an AC power line by an LED pedestrian module shall not exceed twenty percent (20%) over the operating voltage range and temperature range specified above.

I. Production Testing Requirements

1. Each new LED traffic signal lamp unit shall be energized for a minimum of twenty-four (24) hours at operating voltage and at a temperature of 60°C in order to cause any electronic infant mortality to occur, and to ensure electronic component reliability prior to shipment.
2. After the burn-in procedure is completed, each LED traffic signal lamp unit shall be tested by the manufacturer for rated initial intensity at rated operating voltage.

J. Warranty

The manufacturer shall provide a written warranty against defects in materials and workmanship for the LED signal modules for a period of sixty (60) months after installation of the modules. Replacement modules shall be provided promptly after receipt of modules that have failed, at no cost to the Owner except cost of shipping the failed modules. All warranty documentation shall be given to the Engineer prior to installation. The replacement modules shall be delivered to the Traffic Signal Maintenance Shop, within five (5) working days after notification. The warranty does not include the costs associated with removing and reinstalling units that are replaced or repaired.

Article 20.6 Measurement

New and relocated pedestrian signal heads shall be measured as units, complete and in place, including all labor, mounting hardware, equipment, and materials to provide a complete and functioning unit. Measurement shall be for the actual number of existing pedestrian signal heads removed and relocated, and the actual number of new signal heads installed.

Article 20.7 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Pedestrian Signal Head	Each
Remove and Relocate Pedestrian Signal Head	Each

SECTION 80.21 PEDESTRIAN PUSHBUTTONS

Article 21.1 General

Where shown on the Drawings, pedestrian push buttons of substantial tamper-proof construction shall be furnished and installed or relocated. Pedestrian pushbuttons shall be ADA-compliant Bulldog RBDL3-B-4H. Substitutions must be approved by the Municipal Traffic Engineer or designated representative.

The assembly shall be weatherproof and so constructed that it shall be impossible to receive an electrical shock under any weather conditions.

Where a pedestrian pushbutton is attached to a pole, the housing shall be attached to the channel mounting piece and the pole per Detail 80-28 to provide a rigid installation.

Pushbutton and sign shall be positioned on the sidewalk or pathway side of the pole. Arrows on signs shall point in the same direction as the corresponding crosswalk. Pushbutton and sign shall not contain indicator lights unless specified on the Drawings.

Pedestrian pushbutton signs shall be as detailed in the Manual on Uniform Traffic Control Devices (MUTCD) and the Alaska Sign Design Specifications (ASDS). The R10-3E (9"X15") pushbutton sign shall be installed above each pushbutton with the arrow pointing in the direction of the appropriate cross walk. When channel is used for mounting pushbutton signs the top and bottom sign bolt shall be tapped into the pole. Signs shall be in accordance with Division 85, Section 85.04 – Standard Signs.

Article 21.2 Measurement

New and relocated pedestrian pushbuttons shall be measured as units, complete and in place, including all labor, equipment, signs, and other material to provide a complete and working unit. Measurement shall be for the actual number of existing pushbutton assemblies removed and relocated, and the actual number of new pushbutton assemblies installed. Pedestrian pushbutton signs shall not be measured separately, and shall be considered part of the pushbutton assembly.

Article 21.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Pedestrian Pushbutton Assembly	Each
Remove and Relocate Pedestrian Pushbutton Assembly	Each

SECTION 80.22 FLASHING BEACONS

Article 22.1 General

A. Beacons

1. Intersection Control and Hazard Beacons

Each beacon shall consist of one or more single section traffic signal heads, in accordance with the provisions in Section 80.19 - Signal Heads, with yellow or red LED modules as shown on the Drawings.

2. Warning Sign Beacons

Each Warning Sign Beacons shall consist of twelve inch (12") diameter yellow LED signal indications. The number of units, unit configuration and unit installation shall be as shown on the Drawings.

3. Speed Limit Sign Beacons

The 'SCHOOL SPEED LIMIT 20 WHEN FLASHING' (S5-1) sign beacon assembly shall consist of four (4) signal heads with eight inch (8") or twelve inch (12") diameter yellow LED signal indications as shown on the Drawings. They shall be mounted horizontally directly above the S5-1 sign. The two upper beacons shall be illuminated alternately and face oncoming traffic. The lower beacons shall face the opposite direction and be illuminated alternately also.

4. Mast Arm Mounted Sign Beacons

Each mast arm mounted sign beacon assembly shall consist of four (4) twelve inch (12") diameter yellow LED signal indications with backplates, and two signs of the type and size indicated on the Drawings. All signs and signals shall be mounted on the mast arm, with two (2) signals and one (1) sign facing each direction. Any two (2) signals facing the same directions shall be illuminated alternately. Signal heads shall meet the requirements of Section 80.19 - Signal Heads.

B. Control Unit

1. Flashing Beacon Control Unit

The Flashing Beacon Control Unit is to be used for the following: Intersection Control Beacons, Hazard Beacons and Crosswalk Warning Sign Beacons. Each control unit shall be a complete flasher cabinet assembly consisting of an On/Off switch, 15-ampere circuit breaker, surge protector, terminal blocks, flasher socket and NEMA flasher. The enclosure shall be a NEMA Type 3R, and shall be provided with a right side hinged door with locking mechanism.

2. Speed Limit Sign Beacon Control Unit

Each control unit shall be a complete flasher cabinet assembly consisting of a 20-ampere circuit breaker, solid state surge protector, Radio Interference Suppressor, MOV (Metal Oxide Varistor) surge protector, thermostatically controlled incandescent cabinet light with door activated bypass switch, terminal blocks, flasher socket, NEMA flasher and digital time clock. The

enclosure shall be a NEMA Type 3R, and shall be vented and provided with a right side hinged door with locking mechanism.

3. Speed Limit Sign Beacon With Push Button Actuated Warning Beacon Control Unit

Each control unit shall be a complete cabinet assembly consisting of a 20-ampere circuit breaker, solid state surge protector, radio interference suppressor, MOV (Metal Oxide Varistor) surge protector, thermostatically controlled incandescent cabinet light with door activated bypass switch, terminal blocks, flasher socket, NEMA flasher, digital time clock, analog timer and isolation relay. The enclosure shall be a NEMA Type 3R, and shall be vented and provided with a right side hinged door with locking mechanism.

4. Push Button Actuated Warning Beacon Control Unit.

Each control unit shall be a complete cabinet assembly consisting of a 20-ampere circuit breaker, solid state surge protector, Radio Interference Suppressor, MOV (Metal Oxide Varistor) surge protector, thermostatically controlled incandescent cabinet light with door activated bypass switch, terminal block, flasher socket, NEMA flasher, analog timer and isolation relay. The enclosure shall be a NEMA Type 3R, and shall be vented and provided with a right side hinged door with locking mechanism.

C. Control Unit Component Specification

Control unit shall be wired in accordance with the latest cabinet wiring diagram available from the Traffic Signal Maintenance Foreman.

Terminal blocks shall be in accordance with Section 80.17 - Controller Assemblies, except that a single three- (3-) position Box Lug type terminal block capable of accepting three (3) No. 6 AWG wires for terminating power cables must be supplied in all control units.

Switches shall be 15 ampere, single-pole, 120 volt AC.

The Metal Oxide Varistor (MOV), surge protector shall be a V130PA20A.

The cabinet light fixture shall be an incandescent type porcelain lamp holder rated for 660W-250V AC/CA. The lamp shall be 75W.

Flasher socket shall be Cinch-Jones socket S-406-SB, or equivalent.

Flasher shall be a NEMA 2 circuit, solid state, rated at 15 amperes per circuit flasher.

Digital time clock shall be an RTC AP22, or equivalent as approved by the Traffic Signal Maintenance Foreman. Clock to be supplied with Speed Limit Sign Beacon Control Unit and Speed Limit Sign Beacon With Push Button Actuated Warning Beacon Control Unit.

Control unit, complete with all cabinet components, shall be delivered to Traffic Signal Maintenance Shop for testing, prior to installation in the field.

Isolation Relay shall be IDEC power relay model RR2P-U (AC120)

Timer shall be IDEC analog timer RTE-P2 AF20

All other components shall meet the requirements of Section 80.17 - Controller Assemblies.

Article 22.2 Measurement

Flashing beacons, flashing beacon control units, and flashing beacon control units with push button actuated control shall be measured separately as units, complete and in place, including all labor, equipment, and material to provide a complete and working unit.

Article 22.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Intersection Control Beacon	Each
Hazard Beacon	Each
Warning Sign Beacons	Each
Speed Limit Sign Beacon	Each
Mast Arm Mounted Sign Beacon	Each
Flashing Beacon Control Unit	Each
Speed Limit Sign Beacon Control Unit	Each
Push Button Actuated Warning Beacon Control Unit	Each
Speed Limit Sign Beacon with Push Button Actuated Warning Beacon Control Unit	Each

SECTION 80.23 LUMINAIRES

Article 23.1 Luminaire Specification

All luminaire requirements:

1. Light emitting diode (LED) type
2. Minimum operating temperature range -40C to 40C (-40F to 104F)
3. Include a 7-pin receptacle with a shorting cap installed
4. Gaskets shall be composed of a material suitable for the environment.
5. All parts of the luminaire shall be manufactured from corrosion-resistant materials suitable for the environment.
6. Correlated color temperature (CCT) of 3000K.
7. IES BUG Rating U0

Mast arm mounted luminaire requirements:

1. Utilize slip-fitters designed for mounting on 2" O.D. pipe and shall include mounting hardware suitable for the environment.
2. Utilize a flat plate lens with no part of the lens extending below the luminaire's housing.

To ensure the lighting system constructed implements the Engineer's design, the Drawings shall specify the manufacture and manufacture part number for each luminaire, including any shield installed. Luminaires and shields shall be of the type shown on the Drawings.

Design specification of luminaires shall, at minimum, include the following information:

1. Manufacture
2. Model
3. Manufacture Part Number
4. Lumens
5. Longitudinal Light Distribution - Short (S), Medium (M) or Long (L)
6. Transverse Light Distribution - Type I, II, III, IV or V
7. Voltage - Nominal or voltage range if wide range type
8. Correlated color temperature (CCT)
9. Shield Type House, Street or Side (if applicable)
10. Shield Part Number (if applicable)

Manufacturer's luminaire specifications, shop drawings, and photometric data shall be submitted and approved before installing any luminaire on the project.

Article 23.2 Luminaire Substitution

Substitutions of another luminaire shall be approved by the Engineer. A lighting analysis shall be performed to demonstrate the proposed substitution meets the design criteria. The Engineer shall provide an updated electrical sheet with approval of the substitution.

Article 23.3 Measurement

Luminaires shall be measured as units complete and in place, including all labor, equipment, and materials to provide a complete and functioning unit. No measurement for payment shall be made until the functional test has been completed in accordance with Section 80.16, Article 16.2 – Field Tests.

Article 23.4 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Luminaire (Manufacture Part Number)	Each

SECTION 80.24 BALLASTS

Article 24.1 General

Ballasts for high-intensity discharge lamps shall be an integral part of each luminaire and designed for the voltages and lamp types specified in the Drawings or Special Provisions. The current needed to start the lamps shall be less than the operating current.

Ballasts shall be the regulator type with copper windings electrically isolated from each other, and shall start and operate the lamps in temperatures down to -40°F. The allowable line voltage variation shall be at least plus and minus ten percent (10%).

High pressure sodium luminaires, except those with 1000 watt lamps, shall be equipped with magnetic regulator ballasts with the following additional operating characteristics:

1. The lamp wattage regulation spread at any time over the life of the lamp shall not exceed eighteen percent (18%) of nominal lamp watts at plus or minus ten percent ($\pm 10\%$) line voltage variations.
2. With nominal line and lamp voltages, the ballast shall regulate the lamp output to within five percent (5%) of the ballast design center, and sustain lamp operation with a minimum sixty percent (60%) voltage drop lasting four (4) seconds or less.
3. Grounded socket shell.

Luminaires with 1000 watt high pressure sodium lamps shall be equipped with auto-regulator ballasts that provide a maximum thirty percent (30%) lamp regulation spread, a minimum thirty-five percent (35%) voltage dip tolerance, and with nominal line and lamp voltages regulate lamp output to within five percent (5%) of the ballast design center.

Ballasts for use for soffit luminaires shall be furnished with mounting brackets attached and shall be equipped with terminal blocks for primary connections and lamp socket preconnected to the secondary for flush mounted luminaires and with terminal blocks for both primary and secondary connections for use with suspended luminaires.

The Contractor shall submit the ballast manufacturer's volt-watt trace and specification sheets to the Street Light Maintenance Supervisor for review and approval.

Article 24.2 Measurement

This item shall be considered incidental to other Work.

Article 24.3 Basis of Payment

No separate pay item shall be allowed for this item.

SECTION 80.25 FALSEWORK LIGHTING

Article 25.1 General

When required by the Special Provisions, falsework lighting shall be installed where vehicular traffic with or without pedestrian traffic crosses through or under structure falsework.

Illumination of the portal faces of falsework shall be provided during the hours from dusk to dawn. Illumination of the pavement and pedestrian openings through or under falsework shall be provided twenty four (24) hours per day.

The Contractor shall submit a plan of the proposed lighting installations and shall not commence falsework construction until such Drawings have been reviewed by the Engineer. A subsequent review shall be made by the Engineer after falsework lights have been placed in operation.

Fixtures for illumination of roadway pavement between entrances and exit portals shall be enclosed in units with protective cover lens.

Fixture housing shall be heavy gauge, anodized aluminum and shall have an etched, anodized aluminum reflecting surface, or equivalent. Beam spread shall be between one hundred (100) and one hundred thirty (130) degrees.

Fixtures shall be equipped with high temperature glazed porcelain medium base sockets and six foot (6') conductors for splicing, approved by UL for outdoor use.

Fixtures shall be fully adjustable with bracket and locking screws on a mounting plate and shall provide mounting directly to a standard metal junction box.

Fixtures for pedestrian passageways shall be porcelain box receptacles mounted on standard metal junction boxes and equipped with wire lamp guards. Porcelain box receptacles shall be rated at six hundred sixty (660) watts, two hundred fifty (250) volts. Wire lamp guards shall be made of No. 10 AWG wire and shall be suitable for general construction work.

Lamps shall be of the medium base incandescent type. For pavement illumination, lamps shall be one hundred fifty (150) watts minimum. For pedestrian passageway illumination, lamps shall be one hundred (100) watts minimum.

The face of all falsework and forms located within or adjacent to the traveled way, on the approach side, shall be fully illuminated by a minimum of four (4) three hundred (300) watt PAR reflector flood lights directed upon the vertical and horizontal supports. The lights shall be located a minimum of ten feet (10') and a maximum of fifteen feet (15') from the portal faces adjacent to the traveled way and mounted a minimum of twelve feet (12') and a maximum of fifteen feet (15') high. When a median area contains falsework, a minimum of one (1) additional three hundred (300) watt PAR reflector flood light shall be installed in the same manner to illuminate the median support. Each flood light shall be aimed in such a manner as to preclude glare to oncoming motorists. Floodlights shall be mounted on temporary wood poles set in the ground and located on both sides of the traveled way.

For illumination of roadway pavement between entrance and exit portals, a continuous row of fixtures shall be installed over the center of each lane beneath the falsework

structure at intervals of not more than fifteen feet (15'), with the end fixtures not further than seven feet (7') inside the portal faces. Mounting height of fixtures over the pavement shall be as directed.

Pedestrian openings, through or under falsework, shall be illuminated with fixtures centered over the passageway at intervals of not more than fifteen feet (15'), with the end fixtures not more than seven feet (7') inside the portal faces and at a height of ten feet (10'), unless otherwise directed.

For roadway pavement and portal face illumination, No. 12 AWG conductors with Type XHHW insulation shall be used. For pedestrian passageways, conductors shall be No. 12 AWG and enclosed in a one-half inch (1/2") unpainted, zinc-coated metallic conduit.

Contractor shall provide two branch circuits. Pedestrian passageway lights and roadway pavement lights shall be on one (1) circuit and portal face floodlights shall be on a separate circuit. Each branch circuit shall be fused, not to exceed twenty (20) amperes.

The above-specified portal lighting shall be installed on the day that vertical supports are erected and before traffic is permitted to pass between these supports during the hours from dusk to dawn. The other falsework lights shall be installed as soon as the members on which they are to be supported are in place.

Upon completion of the project or when directed, falsework lighting equipment shall remain the property of the Contractor and shall be removed from the site of the Work.

Article 25.2 Measurement

Falsework lighting for each location shall be measured as one lot, installed complete, including all labor, equipment, and material required to provide a complete and functioning system.

Article 25.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Falsework Lighting	Lot

SECTION 80.26 INTERCONNECT CABINET

Article 26.1 General

Install the interconnect cable termination cabinet when called for in the Drawings. All cables shall be terminated in the interconnect cable cabinet and none in the controller cabinet.

Furnish an interconnect termination cabinet that:

1. Is constructed from 16 gauge galvanized steel with an ANSI 61 gray polyester powder coat inside and out.
2. Meets NEMA Standards for Type 3R enclosures.
3. Has a 16-gauge galvanized steel continuous hinge with stainless steel pin.
4. Has a cover fastened securely with captive plated steel screws.
5. Is provided with a hasp and staple for padlocking.
6. Has no gasketing or knockouts.
7. Has no ventilating cover or louvers.
8. Has a standoff mounted back panel with grounding lug assembly.

Article 26.2 Measurement

Interconnect cabinets shall be measured as units installed complete and in place, including all labor, equipment, and material to provide a complete and functioning unit.

Article 26.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Interconnect Cabinet	Each

SECTION 80.27 PROTECTIVE POST ASSEMBLY

Article 27.1 General

Protective post assembly shall be a concrete-filled Schedule 40, steel pipe installed in accordance with the appropriate Standard Details.

Article 27.2 Measurement

Protective post assembly shall be measured as units installed complete and in place, including all labor, equipment, and material to provide a complete and functioning unit.

Article 27.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Protective Post Assembly	Each

SECTION 80.28 SALVAGING ELECTRICAL EQUIPMENT

Article 28.1 General

Unless otherwise specified or shown on the Drawings or Specifications, existing electrical equipment including but not limited to: luminaires, standards, mast arms, poles, caps, handhole covers, mounting bolts, controllers, cabinets, optical detectors, signal heads, pedestrian heads, pedestrian push buttons, push button signs, cameras, radar detectors, service equipment, and junction box lids shall be salvaged and delivered to the Municipality of Anchorage Electronics Warehouse or the Municipality of Anchorage Pole Yard to be placed as directed by the Municipal Traffic Engineer.

Traffic Signal Maintenance personnel and Street Light Maintenance personnel shall be allowed to select the equipment and pole/arm items they would like to salvage. Contractor is responsible for disposal of all remaining items. All poles and arms not selected for salvage shall have the pole plate or arm plate cut off to render the item unusable.

Contractor shall contact the Traffic Signal Maintenance Shop Foreman, at 343-8355, one week prior to the tentative delivery date.

Salvaged poles and mast arms shall be stripped of all wire and hardware and any damaged areas, and exposed hole edges shall be cleaned and painted with cold galvanizing paint in accordance with Section 80.16, Article 16.3 - Galvanizing. All caps, hand-hole covers, mast arms and mounting bolts shall be returned with the pole.

Removal, wire and hardware stripping, listed cleaning and cold galvanize painting, and delivery of all salvaged electrical equipment shall be considered incidental to the Contract and no separate payment shall be made.

When a controller assembly is to be salvaged, the salvage material shall include timing modules, switches, detector control units, conflict monitor unit, and all other equipment contained in the controller cabinet prior to award of the Contract.

Care shall be exercised in removing and salvaging electrical equipment so that it shall remain in its original form and existing condition. The Contractor shall be required to replace, at his expense, any of the abovementioned electrical equipment which has been damaged or destroyed by his operations.

Unless otherwise specified, underground conduit, conductors, foundations and detector loops not reused shall become the property of the Contractor and shall be removed from the project Right-of-Way. If said materials do not interfere with other construction, they may, with approval from the Engineer, be abandoned in place except that conductors must be removed from conduit prior to abandonment. Foundations abandoned in place shall conform to the requirements of Section 80.03 – Removing and Replacing Improvements.

Holes formed by removing pull boxes and foundations shall be filled with material equivalent to the original and compacted to the same density as the surrounding material.

When existing electrical equipment is to be reused, the Contractor shall furnish and install all necessary materials and equipment, including signal mounting brackets, anchor bolts, nuts, washers and concrete as required to complete the new installation.

All traffic signal, flashing beacon and lighting fixtures to be reinstalled shall be cleaned, relamped, and reconditioned in accordance with Section 80.16, Article 16.4 – Painting for Structures.

Salvaged materials required to be reused and found to be unsatisfactory by the Engineer shall be replaced by new material and the cost shall be paid as extra Work as provided in Division 10, Sections 10.05 – Control of Work and 10.07 – Measurement and Payment.

Article 28.2 Measurement

Measurement for removal of poles in this Section is per each unit removed; and includes all work and materials necessary to remove poles, hardware disposal, cutting poles to render them unusable, disassemble, salvage, disposal, and delivery to the Municipality of Anchorage Pole Yard as specified in the Drawings or in the Special Provisions. When Drawings are unclear as to the method of pole salvage or disposal, the Contractor shall contact the Municipal Traffic Engineer to receive specific instructions.

Removal of the pole foundation, in accordance with Section 80.03 - Removal and Replacing Improvements, and disposal of the pole foundation is incidental to the pay items in this Section. Salvage and delivery of existing signs, signal hardware and illumination hardware shall also be considered incidental to the pole removal pay items.

If Owner declines ownership, the poles, mast arms, and associated hardware become Contractor property.

Article 28.3 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following units:

ITEM	UNIT
Remove Luminaire Pole	Each
Remove Signal Mast Arm or Combination Pole	Each
Remove Signal Pedestal or Pedestrian Pushbutton Pole	Each

SECTION 80.29 RADAR SPEED SIGN

Article 29.1 General

Work under this Section consists of the performance of all operations pertaining to furnishing and insalling the radar speed sign, including the labor, equipment, and materials, in accordance with the Drawings.

Article 29.2 Manufacturer

Radar speed sign shall be the "VCalm YS" traffic calming sign as manufactured by Fortel Traffic Inc. (<https://www.vcalm.com>) or approved equal.

Article 29.3 Materials

Contractor shall provide new, undamaged materials to meet the requirements specified on the Drawings and in these Specifications.

A. Radar Speed Sign

1. Contractor shall install a radar speed sign at the locations shown in the Drawings or as directed by the Engineer. Mount signs to a new 13' breakaway traffic signal pole or electrolier in accordance with the Plans.
2. Radar speed sign shall have the approximate overall dimensions 45" (h) x 28.5" (w) x 4.5" (d).
3. Radar speed sign shall be UL listed.
4. Sign enclosure shall be rated NEMA-3R and be constructed of 11-gauge (0.090) continuous formed aluminum. Finish shall be black powder coat.
5. Upper display shall be static plaquards, but have the option to be upgradable to a variable Light Emitting Diode (LED) message display in the future. The upper display shall read "YOUR SPEED" in two rows with approximate overall dimensions: 12" (h) x 20".
6. Lower display shall be numerals consisting of amber LEDs and have the approximate overall dimensions: 16" (h) x 18" (w). Lens shall be 3/8" polycarbonate.
7. Sign shall have a receptacle capable of receiving an SD card for programming and data retrieval.
8. Install the following optional modules with the radar speed sign:
 - a. Wireless IP Modem/VSpeed Online for programming
 - b. Flashing Strobe for when speeds above the posted speed limit are detected
9. Includes 5 year wireless service subscription.
10. If a means to mount the sign to the pole are not included in the sign kit, or are unstable, the Contractor shall provide mounting hardware in accordance with M.A.S.S., these Special Provisions, and manufacturer's instructions, subject to approval by the Engineer.

11. Provide a short length of RMC between radar speed sign and pole or post, unless directed otherwise by the manufacturer's instructions or the field engineer. Conduit penetration shall be at the sign bottom unless otherwise directed. Pull radar speed sign cable through RMC and terminate.

12. Install a new R2-1 sign as shown on the drawings.

Article 29.4 Construction

MOA Traffic to be onsite for field installations. Contact Traffic Engineering Department (907-343-8479) seven (7) working days prior to planned field installations. Provide Traffic Engineering Department twenty four (24) hours notice prior to actual installations. Failure to notify Traffic Engineering Department may result in delay of work and withholding of payment. The Owner may withhold from any progress payment the sum of \$500 per day as liquidated Damages for each and every calendar day the Contractor delays notification to Traffic Engineering Department.

Contractor shall install the radar speed sign according to the manufacturer's instructions and in accordance with the Drawings or as directed by the Engineer. Contractor shall ensure that the radar speed sign is level and correctly orientated. Repair any damage to galvanized finishes according to Article 16.3.

Field locate all utilities and existing lighting circuits according to Article 1.1. Hand dig when within 2 feet of utilities.

Route conduit as shown in the Drawings or as directed by the Engineer. Utilize existing junction boxes and conduit where shown in the Drawings for the radar speed sign circuit.

Install new R2-1 signs at radar speed signs as shown on the drawings.

Article 29.5 Measurement

The radar speed sign system shall be measured as units, complete and in place. Any required mounting hardware is subsidiary to this pay item. Conduit and conductors required for the connection of the radar speed sign system shall be paid for separately under Sections 80-07 and 80-10. The foundation and breakaway traffic signal pole shall be paid for under Sections 80-04 and 80-05. The R2-1 speed limit sign shall be paid for under Section 85.04. Mounting hardware shall be subsidiary to this pay item. All salvage and demolition efforts described in this section shall be subsidiary to this pay item.

Radar speed signs indicated as spares shall be delivered to Street Light Maintenance, 343-8372 prior to final acceptance. Contact Street Light Maintenance a minimum of three business days prior to delivery. The Engineer retains the right to inspect all radar speed signs for conformance with the contract documents prior to accepting delivery. The cost of storage prior to delivery and delivery of these materials is subsidiary to the pay item.

Article 29.6 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following unit:

ITEM	UNIT
Radar Speed Sign	Each
Radar Speed Sign, Spare	Each

SECTION 80.30 HEAT TRACE SYSTEM

Article 30.1 General

The Work under this Section consists of performing all operations pertaining to furnishing and installing a heat trace system as required by the Drawings and these Specifications.

Locations of heat cables, manholes, catch basin and storm drain services, and appurtenances shown on the Drawings are approximate and the exact locations shall be established in the field in consultation with the Engineer.

Materials furnished shall be new, except such used materials as may be specifically provided for on the Drawings or Special Provisions. Where an existing system is to be modified, the existing materials shall be reused on the project or disposed as shown on the Drawings or in the Special Provisions.

All systems shall be complete and in operation with all materials in conformance with Contract Documents at the time of final acceptance.

Article 30.2 Regulations and Codes

Work shall be as specified in Division 80, Section 80.01, Article 1.2 - Regulations and Codes and this Section.

Heat cables shall be provided with Factory Mutual or UL listing indicating approval for freeze protection in the indicated locations shown on the Drawings and specified herein.

Article 30.3 Equipment Lists and Drawings

Work shall be as specified in Division 80, Section 80.01, Article 1.3 - Equipment List(s) and Drawings and this Section. Submittals shall include:

1. Manufacturer's installation and testing instructions.
2. Operations and maintenance instructions.
3. Complete control diagrams in block and schematic form indicating wire sizes, raceway sizes, locations, component configurations, equipment layouts, and all other information necessary to completely describe each and every portion of the controls installation.
4. MEGGER reports before and after installation.

Article 30.4 Warranties, Guarantees, and Instruction Sheets

Provide in accordance with Division 80, Section 80.01, Article 1.4 - Warranties, Guarantees, and Instruction Sheets.

Article 30.5 Safety Precautions

Before starting Work on existing heat cable systems, Contractor shall disconnect and lock-off load centers feeding circuits for the heat trace system. Disconnection shall be made by utility or main and branch breakers locked in "off" position.

Suitable signs shall be posted at load centers when Contractor is working on any of the circuits fed from the load center.

Article 30.6 Materials

Self-limiting thermoplastic insulation, parallel resistance heating cable with a 300-volt insulation rating, with output of eight (8) watts/linear foot at a 240-volt single phase operation and tinned copper metal braid with fluoropolymer overjacket as manufactured by Thermon Type FLX (8-FLX-2-FOJ). Substitutions: Items of other manufacturers of same quality, construction, rating, capacity, function, and characteristics may be acceptable.

Labeling on cable: Manufacturer, catalog number, rating in volts, or in volts and AMPS.

Color coding: Non-heating lead wire shall be red for 240-volt nominal circuit voltage.

Contractor shall supply an isolated ground wire for each circuit.

Contractor shall install cables in accordance with manufacturer's recommendations for this application.

The heat cable insulation's resistance and continuity shall be tested in accordance with methods and times as required in manufacturer's recommendations. Tests shall be conducted and test results recorded at the following minimum times:

1. When the cable arrives on the job site before installation.
2. After it is installed completely.

Contractor shall install heat cable(s) in galvanized rigid conduit and junction boxes in manholes, storm drains, and other parts of storm drain systems as shown on the Drawings. Conduit placed within culverts shall be installed at one half the radius of the culvert or as shown on the Drawings and secured 2-hole conduit straps attached to the culvert wall using galvanized lag screws, lock washers, and nuts. Supports shall not be placed further apart than 10 feet where practicable.

End terminations in manholes and lift stations shall be in cast junction boxes with gasketed covers and installed above the normal water line. End terminations above grade shall be in NEMA 3R junction boxes.

Liquidtight flexible metallic conduit (LFMC) for heat trace may be run within storm drain structures.

Contractor shall install cable in a single length without splices or joints. Contractor shall provide bonding and grounding of drain in accordance with cable manufacturer's recommendations. All cold lead to heat trace connections and end terminations shall be accessible and waterproof.

All cables shall be protected by 30 mA GFI circuit breakers.

For heat trace system with automatic controls, provide a load center or standalone control panel with the following items:

- Selector switch: Single pole – 3 position with contacts rated 10 Amps at 120V. Label the switch "HEAT TRACE CONTROL" and the switch positions H = "ON", O = "OFF", A = "THERMOSTAT".
- Remote Bulb Thermostat: Open on Rise, SPDT remote bulb thermostat, 120/240VAC, -30°F to 90°F range.

- Contactor: 30A with number of poles as shown on the drawings with contacts rated 60A resistive at 240V and a 120V control coil.
- Pilot Light: 120V light emitting diode (LED) with green lens, NEMA 4X rated in outer door of enclosure. Label "HEAT TRACE ON".
- Enclosure Heater: Thermostatically controlled 120V fan driven heater sized per the Drawings.

Contractor shall secure cable in dead-end raceways in accordance with manufacturer's recommendations to ensure cable remains in place after installation.

See Drawings for additional installation requirements.

Contractor shall mount all components grouped neatly and securely fastened to surfaces in accordance with manufacturer's recommendations.

Provide engraved nameplate at junction box serving heat cables in each storm drain manhole. Nameplate shall be white letters on red background and include the message "WARNING 240 V. HEAT CABLE(S)" and include load center location.

Article 30.7 Measurement

The length of measurement shall be the horizontal length of the storm drain systems to be heat traced. Measurement includes all terminations, markings, and incidental supplies as required to meet the provisions of this Section. Cables installed in manholes and catch basins shall not be measured, but rather the following distances shall be considered standard unless determined otherwise by the Engineer.

- Manhole forty feet (40')
- Catch Basin sixteen feet (16')

Article 30.8 Basis of Payment

Payment for this Work shall be in accordance with Division 10, Section 10.07 - Measurement and Payment, and shall include full payment for all Work described in this Section.

Payment shall be made under the following unit:

ITEM	UNIT
Heat Trace	Linear Foot

**MUNICIPALITY OF ANCHORAGE
STANDARD SPECIFICATIONS**

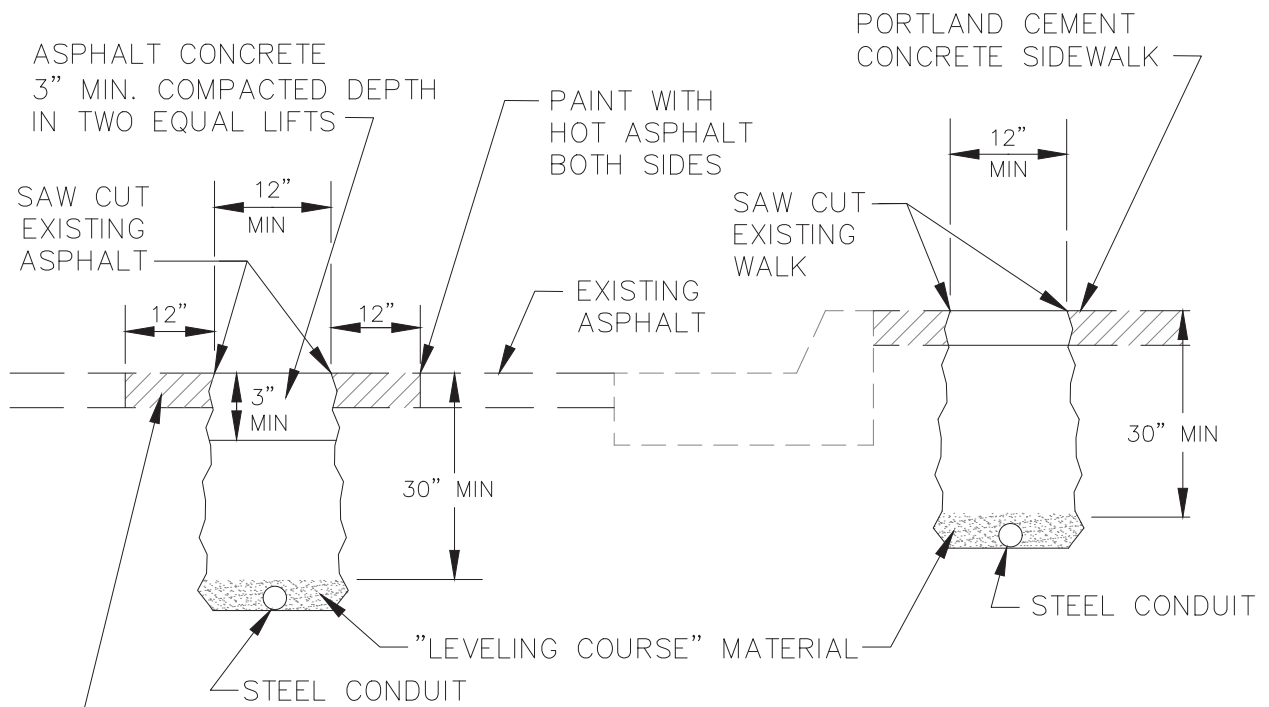
**DIVISION 80
TRAFFIC SIGNALS AND ILLUMINATION
STANDARD DETAILS**

**STANDARD CONSTRUCTION SPECIFICATIONS
DIVISION 80
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AFTER TRENCH BACKFILL HAS BEEN COMPACTED AN ADDITIONAL 12" OF ASPHALT WILL BE REMOVED FROM EACH EDGE OF THE ORIGINAL CUT. THE ENGINEER MAY REQUIRE MORE THAN A 12" ADDITIONAL CUT IF THE EXISTING PAVEMENT HAS BEEN LIFTED IN THE REMOVAL PROCESS OR IF THE JOINT DOES NOT OCCUR ON UNDISTURBED MATERIAL.

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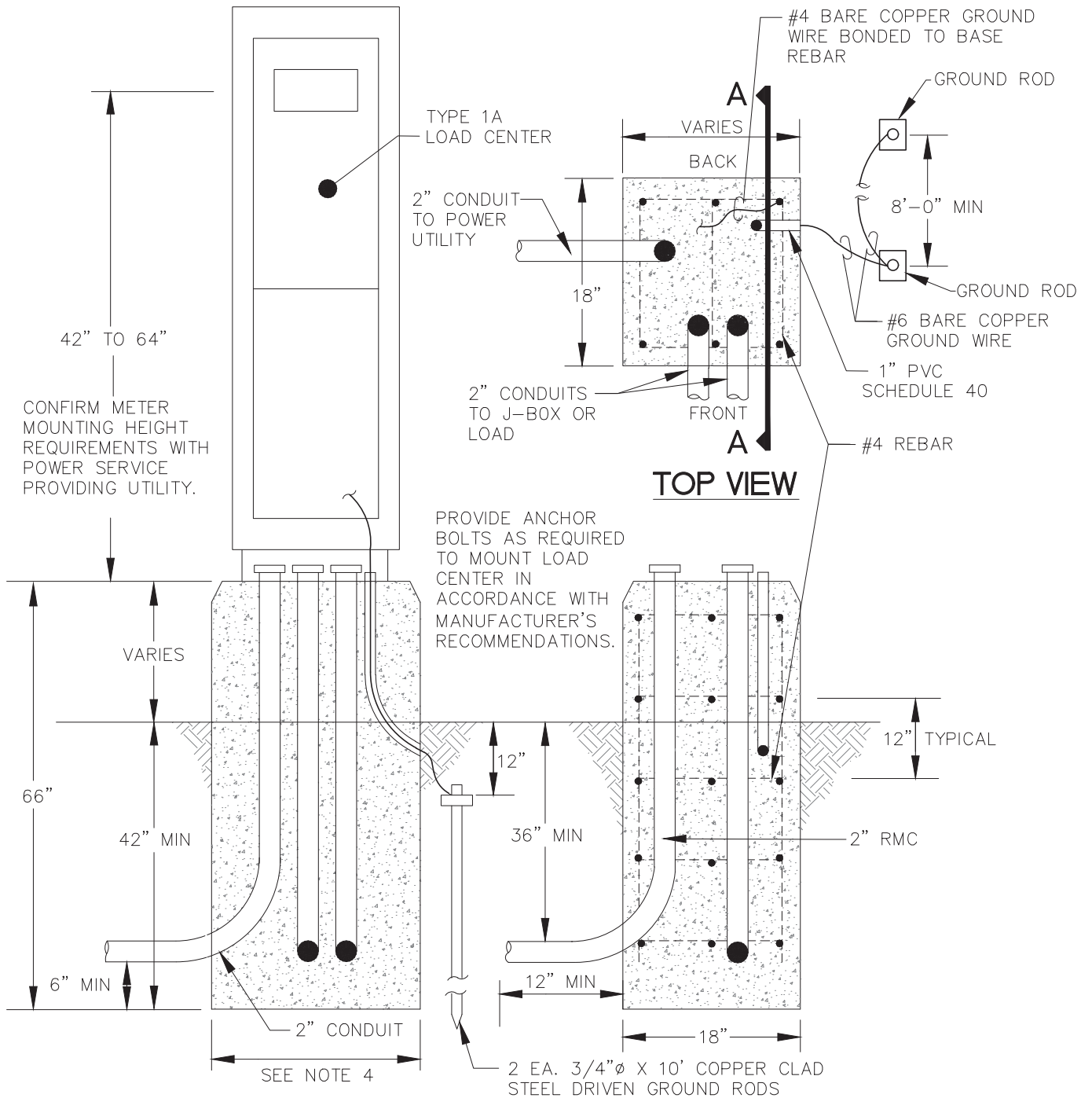
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REVISED: 2/24

SAW CUT TRENCH

SECTION # 80.02

DETAIL # 80-1



NOTES:

1. ORIENTATION OF CONDUIT SWEEPS IS REPRESENTATIVE. CONTRACTOR SHALL COORDINATE CONDUIT ORIENTATION WITH THE ENGINEER AND UTILITY.
2. PROVIDE NON-FROST SUSCEPTIBLE COMPACTED BACKFILL.
3. INSTALL A TYPE 1A OR TYPE 2 JUNCTION BOX ADJACENT TO LOAD CENTER FOUNDATION. JUNCTION BOX SIZE TO BE DETERMINED USING THE LATEST VERSION OF MOA DESIGN CRITERIA MANUAL, CHAPTER 6.
4. THE BASE DIMENSIONS OF THE FOUNDATION SHALL BE SIZED FOR THE LOAD CENTER BEING INSTALLED SUCH THAT THE LOAD CENTER DOES NOT OVERLAP THE 1" CHAMFER ON ALL SIDES.

FRONT VIEW

SECTION AA

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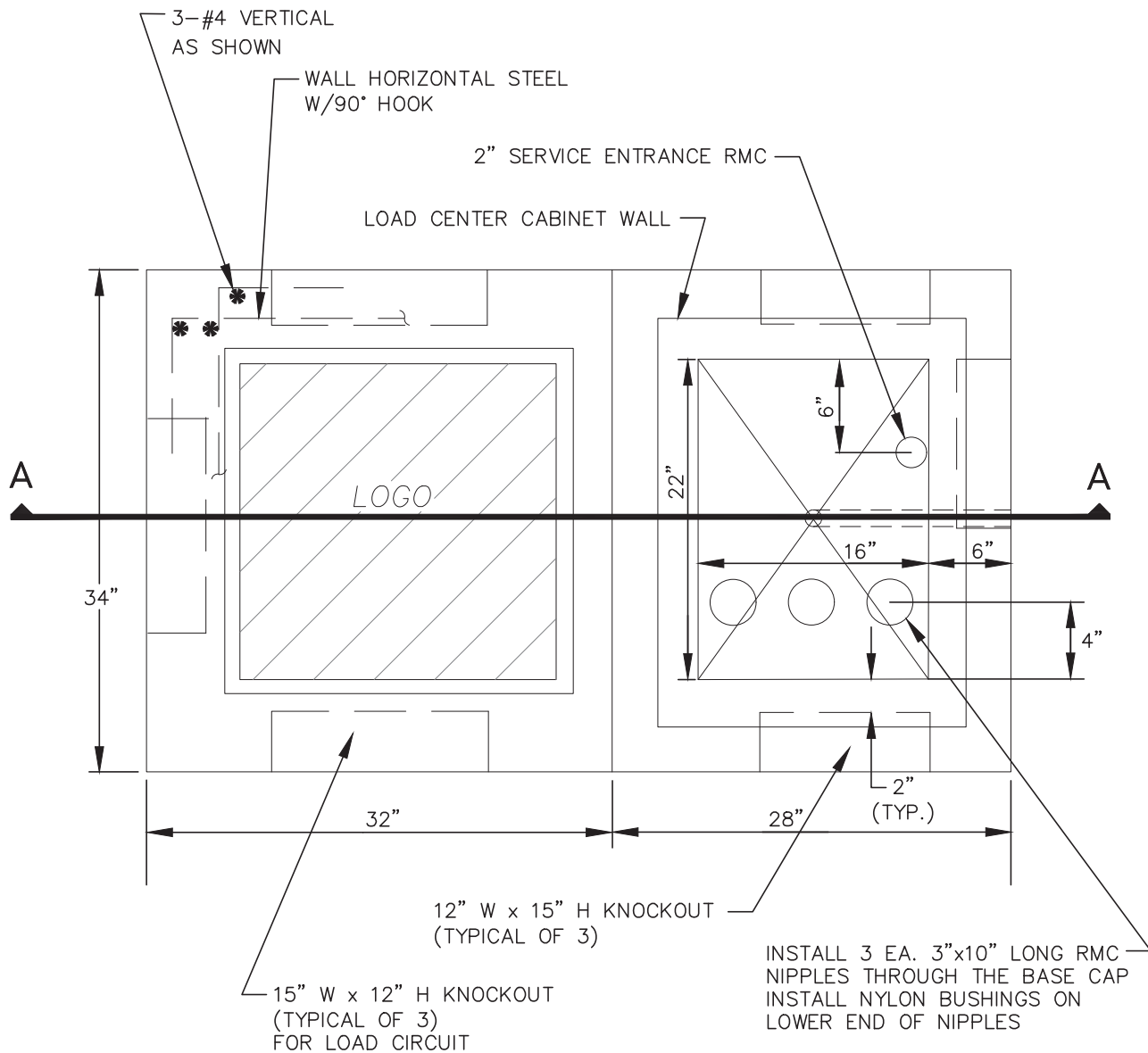
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 APPROVED:
 REVISED:
2/24

**CONCRETE FOUNDATION
 LOAD CENTER
 TYPE 1A**

SECTION #
80.04
 DETAIL #
80-2



PLAN VIEW

NOTE:

1. SEE DETAIL 80-4 FOR SECTION AA.

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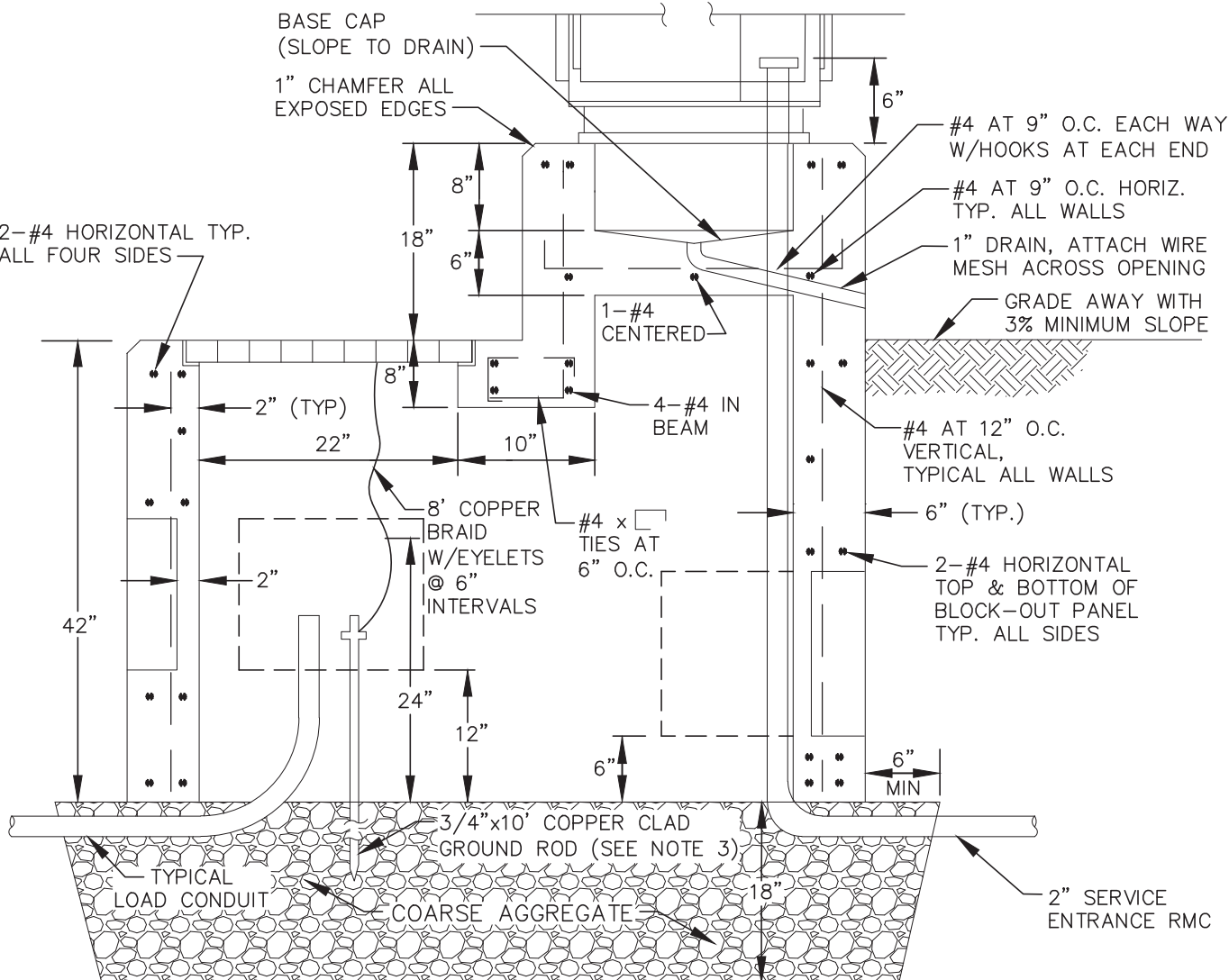
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**CONCRETE FOUNDATION
 LOAD CENTER
 TYPE 1**

SECTION #
80.04

DETAIL #
80-3




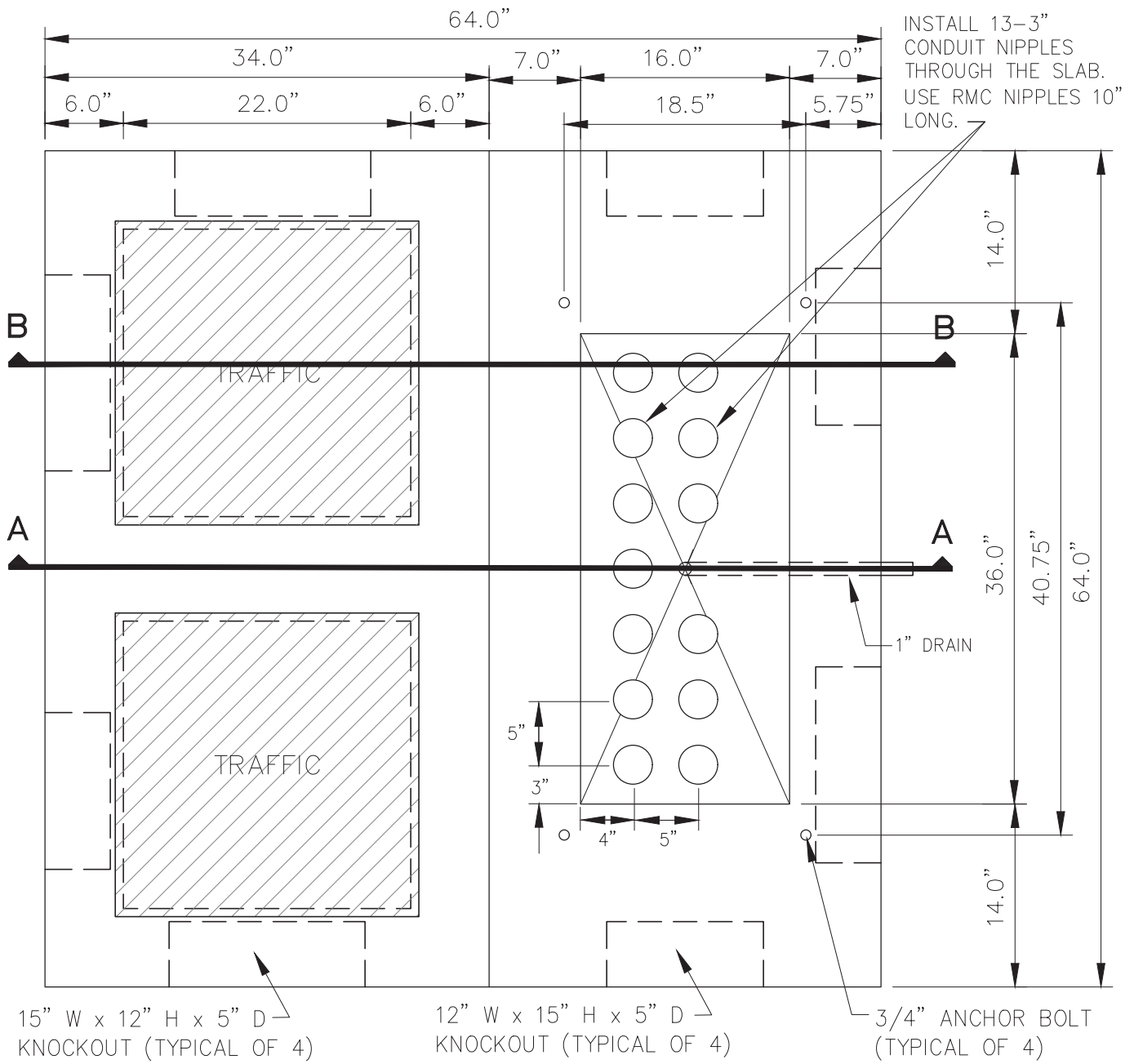
SECTION AA

NOTES:

1. STOP HORIZ. & VERT. STEEL AT BLOCK-OUT PANELS & USE 90 HOOK. USE 2-#4 HORIZ. & VERT. EXTRA BARS ALL SIDES AS SHOWN.
2. SEE STANDARD DETAIL 80-3 FOR PLAN VIEW.
3. ADD SECOND 3/4" x 10' GROUND ROD 8' FROM LOAD CENTER PER NEC.

REVISION: 2024 M.A.S.S. UPDATE

 MUNICIPALITY OF ANCHORAGE	SCALE: N.T.S. APPROVED: REVISED: 2/24	<h2 style="margin: 0;">CONCRETE FOUNDATION TYPE 1 LOAD CENTER SECTION AA</h2>	SECTION # 80.04 DETAIL # 80-4
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PLAN VIEW

NOTES:

1. SEE STANDARD DETAIL 80-6 FOR SECTION AA
2. SEE STANDARD DETAIL 80-7 FOR SECTION BB.
3. ANCHOR BOLTS SHALL NOT PROTRUDE MORE THAN 1.5" ABOVE THE TOP OF THE FOUNDATION. CONTRACTOR SHALL USE ANCHOR BOLT DIMENSIONS SPECIFIED BY THE CABINET MANUFACTURER.
4. SEAL UNUSED CONDUIT STUBS WITH WATERTIGHT CAPS. SEAL STUBS CARRYING CONDUCTORS WITH DUCT SEAL TO SEAL AROUND CONDUCTORS AND AGAINST THE CONDUIT WALLS.
5. INSTALL TRAFFIC CONTROLLER WITHIN 1-DEGREE OF PLUMB.

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MUNICIPALITY



OF ANCHORAGE

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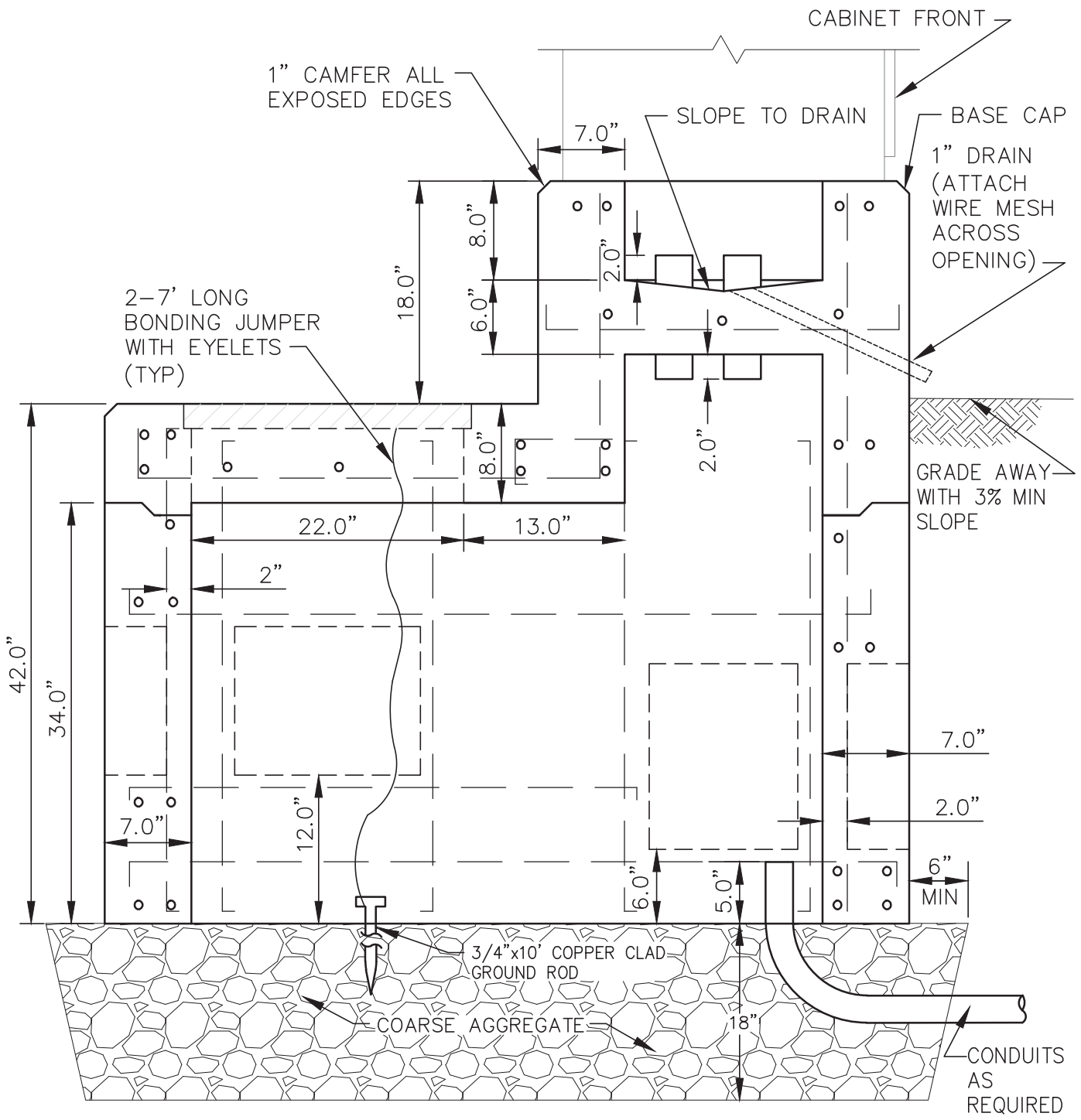
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2/24

TS2 CONTROLLER CONCRETE CABINET FOUNDATION

SECTION #
80.04

DETAIL #
80-5



SECTION AA

NOTE:
 1. SEE STANDARD DETAIL 80-7, SECTION BB, FOR REBAR DETAILS.

REVISION: 2024 M.A.S.S. UPDATE

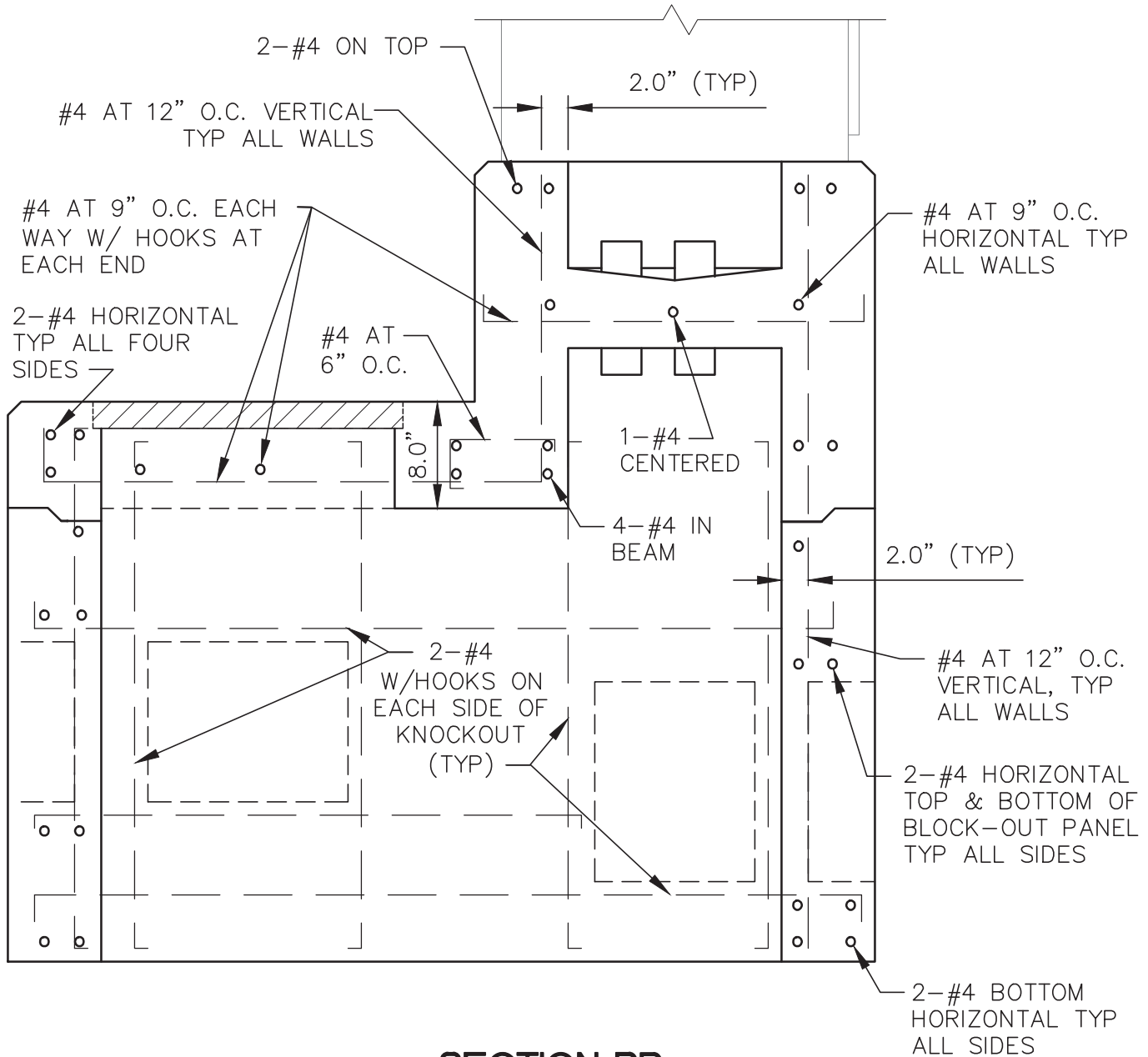
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SCALE:
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 2/24

**CONCRETE FOUNDATION
 TS2 CONTROLLER
 SECTION AA**

SECTION #
 80.04
 DETAIL #
 80-6



SECTION BB

NOTE:

STOP HORIZONTAL & VERTICAL STEEL AT THE BLOCK-OUT PANELS & THE JOINT USING 90 DEGREE HOOKS. USE 2 EXTRA #4 HORIZONTAL & VERTICAL BARS ALL SIDES AS SHOWN.

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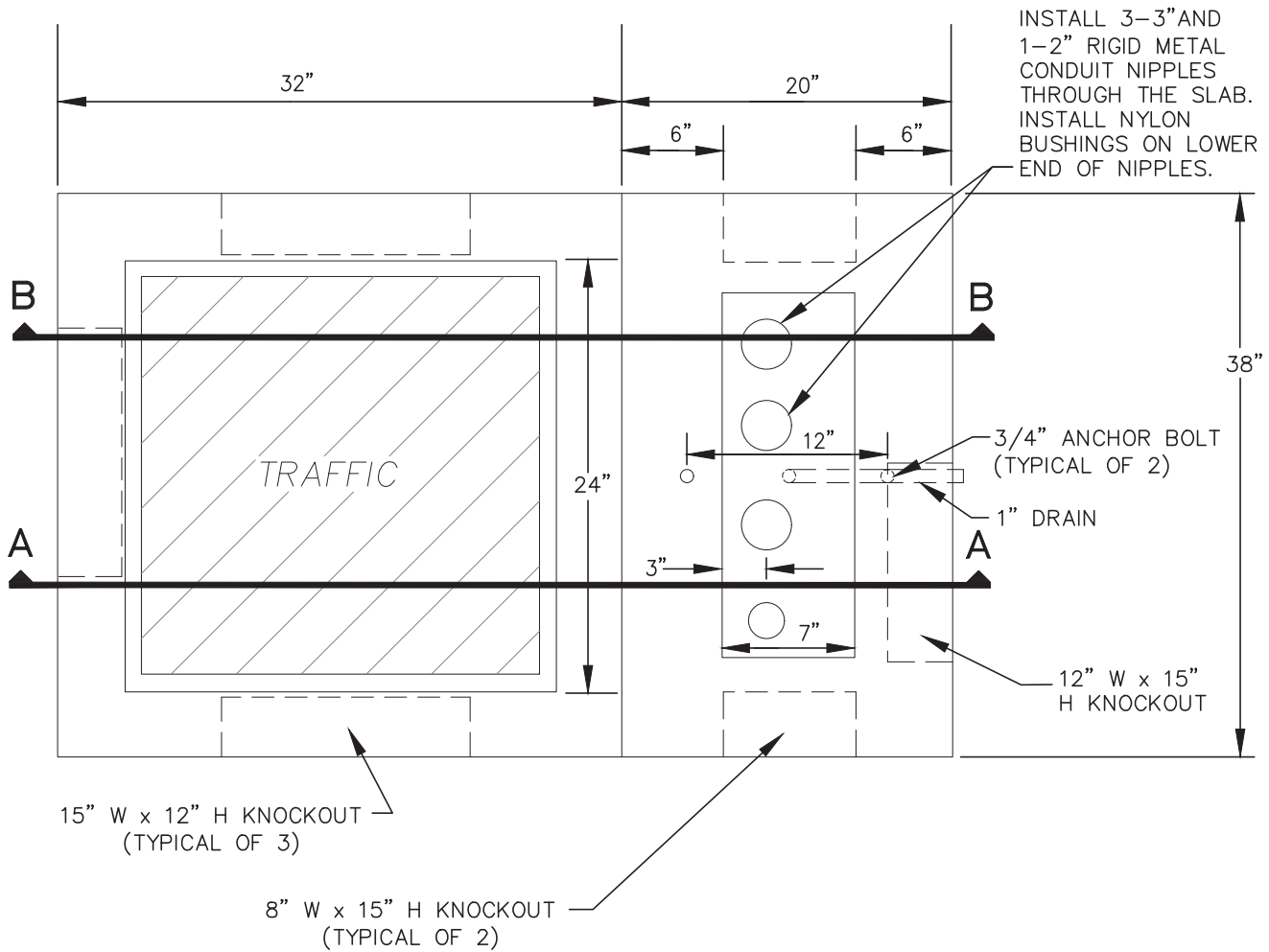
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**CONCRETE FOUNDATION
 TS2 CONTROLLER
 SECTION BB**

SECTION #
80.04
 DETAIL #
80-7



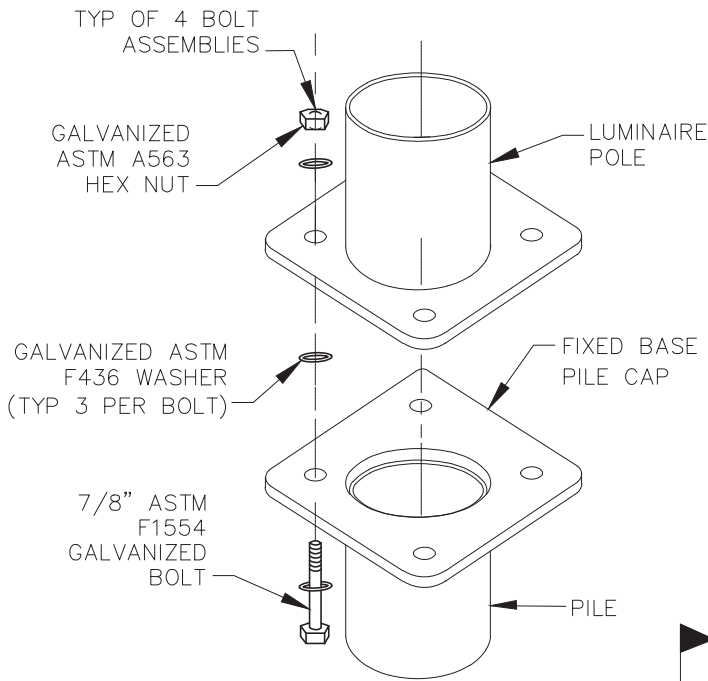
PLAN VIEW

NOTES:

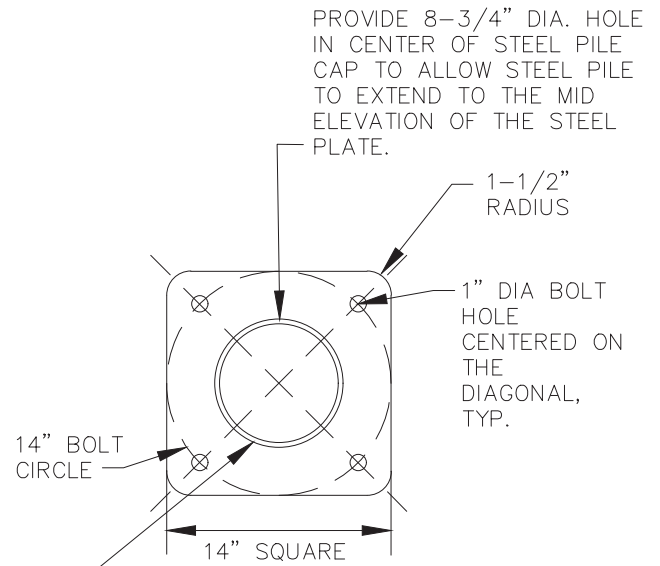
1. SEE DETAIL 80-6 FOR SECTION AA.
2. SEE DETAIL 80-7 FOR SECTION BB.
3. ANCHOR BOLTS SHALL NOT PROTRUDE MORE THAN 1-1/2" ABOVE THE TOP OF THE FOUNDATION. USE CABINET MANUFACTURER SPECIFIED ANCHOR BOLT DIMENSIONS.
4. SEAL UNUSED CONDUIT STUBS WITH WATERTIGHT CAPS.

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 MUNICIPALITY OF ANCHORAGE	SCALE: N.T.S. APPROVED: REVISED: 2/24	<h2 style="margin: 0;">VAULT TYPE "M"</h2> <h1 style="margin: 0;">CONTROLLER CABINET</h1> <h1 style="margin: 0;">FOUNDATION</h1>	SECTION # 80.04 DETAIL # 80-8
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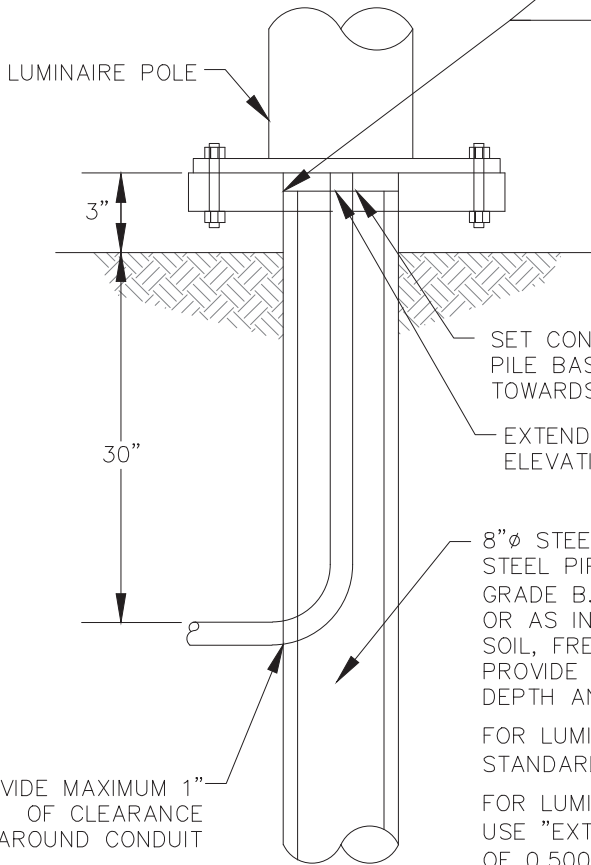


FIXED BASE ASSEMBLY



WELD IN CONFORMANCE WITH AWS D1.1 BY WELDERS CERTIFIED FOR AWS 6G QUALIFICATION TEST.
 USE 3/8" WELD FOR 1-1/2" PLATE & 1/2" WELD FOR 2" PLATE

1. PROVIDE 1-1/2" THICK PLATE FOR LUMINAIRE POLES 40' AND LESS IN LENGTH. PROVIDE 2" THICK PLATES FOR LUMINAIRE POLES FROM 40 FEET TO 50 FEET IN LENGTH.
2. BOLT HOLES MAY BE DRILLED OR PLASMA CUT WITH MAXIMUM 1/8" LEAD-IN NOTCH.



SET CONDUIT FLUSH WITH TOP OF PILE BASE PLATE AND SLOPE TOWARDS LIGHT POLE HAND HOLE
 EXTEND THE PIPE PILE TO THE MID ELEVATION OF THE STEEL PIPE CAP

8"Ø STEEL PIPE PILE:
 STEEL PIPE USED FOR PILING SHALL CONFORM TO ASTM A53, GRADE B. CONTRACTOR SHALL PROVIDE A 15' MINIMUM EMBEDMENT OR AS INDICATED IN DRAWINGS FOR PILING INSTALLED IN GRANULAR SOIL, FREE OF ORGANICS AND DEBRIS. FOR OTHER CONDITIONS, PROVIDE A FOUNDATION INVESTIGATION TO DETERMINE EMBEDMENT DEPTH AND OTHER PILE DESIGN CRITERIA.

FOR LUMINAIRE POLES 40 FEET OR LESS IN LENGTH, USE STANDARD STEEL PIPE PILES WITH A WALL THICKNESS OF 0.322".

FOR LUMINAIRE POLES BETWEEN 40 FEET AND 50 FEET IN LENGTH, USE "EXTRA STRONG" STEEL PIPE PILES WITH A WALL THICKNESS OF 0.500".

PROVIDE MAXIMUM 1" OF CLEARANCE AROUND CONDUIT

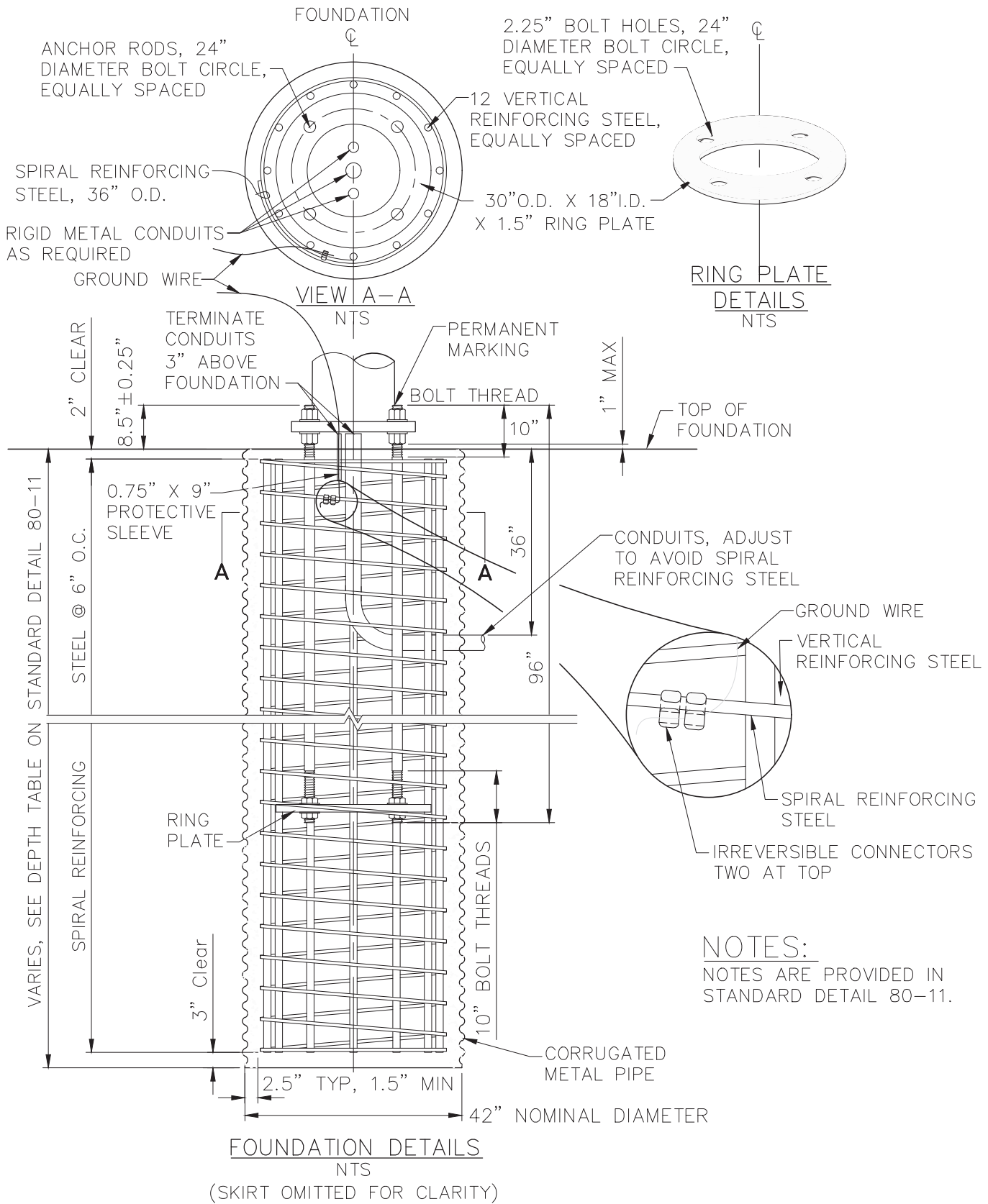
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REVISOR:
2/24

**DRIVEN PILE LUMINAIRE
 POLE FOUNDATION
 FIXED BASE**

SECTION #
80.04
DETAIL #
80-9



NOTES:
 NOTES ARE PROVIDED IN STANDARD DETAIL 80-11.

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SIGNAL POLE FOUNDATION DETAILS CONCRETE 42" DIAMETER

SECTION #
 80.04


DETAIL #
 80-10

NOTES:

1. THIS FOUNDATION IS APPROVED FOR TRAFFIC SIGNAL APPLICATIONS IN COHESIONLESS SOILS WITH AN N1-60 VALUE OF 10 OR GREATER PER AASHTO T-206, "STANDARD PENETRATION TEST" (SPT). THIS FOUNDATION SHALL NOT BE USED IF ANY OF THE FOLLOWING ARE ENCOUNTERED; WATER TABLE ABOVE THE BOTTOM OF FOUNDATION, VERY LOOSE SOILS, ORGANIC SOILS OR, COHESIVE SOILS (CLAY), OR SOILS SUSCEPTIBLE TO FROST JACKING. IF ANY OF THESE CONDITIONS ARE ENCOUNTERED, STOP FOUNDATION WORK AND CONTACT THE ENGINEER.
2. PLACE FOUNDATION IN DRILLED OR EXCAVATED HOLE WITH CENTERLINE OF FOUNDATION LOCATED AT THE STATION, OFFSET, AND ELEVATION SPECIFIED IN PLANS. SET FOUNDATION FLUSH WITH SURROUNDING SURFACE. GRADE TO DRAIN AWAY FROM FOUNDATION WITHOUT EXPOSING MORE THAN 4" OF THE FOUNDATION FROM THE SURROUNDING GROUND SURFACE.
3. FORM THE FOUNDATION IN CORRUGATED METAL PIPE CONFORMING TO M.A.S.S DIVISION 80, SECTION 80.04, ARTICLE 4.2 – CAST-IN-PLACE CONCRETE FOUNDATIONS.
4. PROVIDE 1.5 EXTRA TURNS AT EACH END OF THE SPIRAL REINFORCING STEEL. REINFORCING STEEL SHALL NOT BE SPLICED. TIE VERTICAL REINFORCING STEEL TO EACH INTERSECTION OF THE SPIRAL REINFORCING STEEL.
5. CONNECT GROUND WIRE NEAR THE TOP SPIRAL REINFORCING STEEL WITH TWO IRREVERSIBLE CONNECTORS AS SHOWN. FASTEN CONNECTORS ACCORDING TO THE MANUFACTURERS' RECOMMENDATIONS INCLUDING THE USE OF MANUFACTURER SPECIFIED TOOLS. THE GROUND WIRE MAY BE BARE SOLID, STRANDED, OR BRAIDED COPPER. PROTECT GROUND WIRE WITH PROTECTIVE SLEEVE AS SHOWN AND FILL WITH SILICON SEALANT.
6. THE RING PLATE MAY BE "BUILT UP" OF MULTIPLE STEEL PLATES. THE MINIMUM THICKNESS FOR ANY ONE PLATE IS 0.5 INCHES. FASTEN THE RING PLATE TO ANCHOR RODS WITH NUTS AND WASHERS ON BOTH SIDES OF RING PLATE AS SHOWN. TORQUE RING PLATE NUTS TO 600 FT-LBS.
7. ANCHOR RODS ARE SUBJECT TO CHARPY V-NOTCH IMPACT TESTING. SUBMIT MILL CERTIFICATIONS FOR ANCHOR RODS, NUTS AND WASHERS. GALVANIZE ANCHOR RODS FULL LENGTH. PROVIDE PERMANENT MANUFACTURER'S IDENTIFICATION AND PERMANENT GRADE IDENTIFICATION ON EACH END OF ANCHOR ROD BY STEEL DIE STAMP. SECURE EXPOSED ANCHOR RODS WITH A "RING PLATE" WHEN NOT IN SERVICE. INSTALL ANCHOR RODS PLUMB. ANCHOR RODS GREATER THAN 1:40 OUT-OF-PLUMB WILL RESULT IN FOUNDATION REJECTION.
8. COMPLETE ALL CONCRETE WORK IN CONFORMANCE WITH M.A.S.S. DIVISIONS 30 – CONCRETE AND 80 – TRAFFIC SIGNALS AND ILLUMINATION. USE A TUBE WITH A HOPPER HEAD OR OTHER APPROVED DEVICE WHEN DROPPING CONCRETE MORE THAN 5 FEET. VIBRATE CONCRETE DURING PLACEMENT BY MECHANICAL VIBRATION. ENSURE UPPER ANCHOR ROD THREADS ARE PROTECTED FROM CONTACT WITH CONCRETE DURING POUR.
9. BACKFILL AND COMPACT ACCORDING TO M.A.S.S. DIVISION 20 – EARTHWORK AND DIVISION 80, SECTION 80.04, ARTICLE 4.2 – CAST-IN-PLACE CONCRETE FOUNDATIONS. USE CLASSIFIED FILL & BACKFILL, TYPE II OR TYPE II-A. ENSURE AREA BELOW FOUNDATION MEETS COMPACTION REQUIREMENTS AND IS FREE OF LOOSE MATERIAL AND DEBRIS PRIOR TO CONCRETE WORK.

DEPTH TABLE		
MASTARM(S) LENGTH (FT)	FOUNDATION DEPTH BY APPLICATION (FT)	
	SINGLE MASTARM	DOUBLE MASTARM
L <= 40	10	13
40 <= L <= 50	11	14
55 <= L <= 65	12	15

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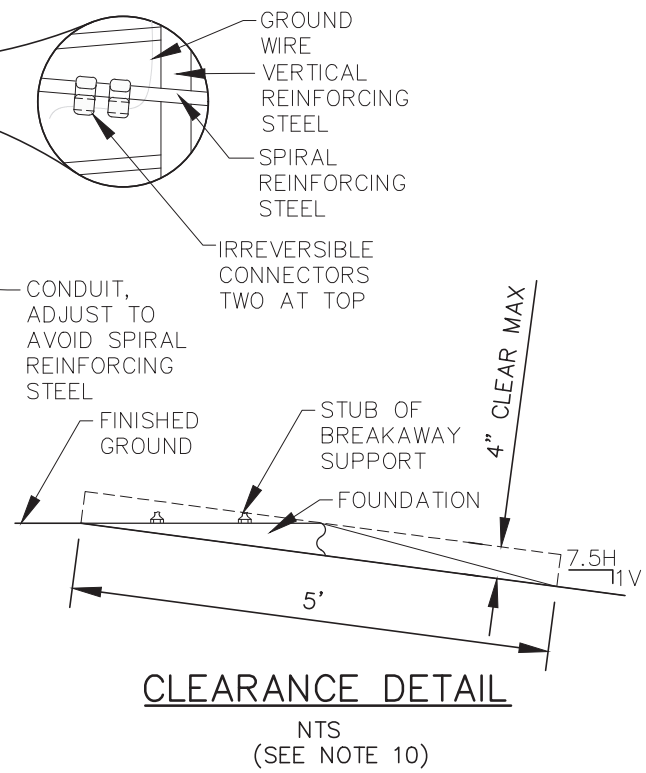
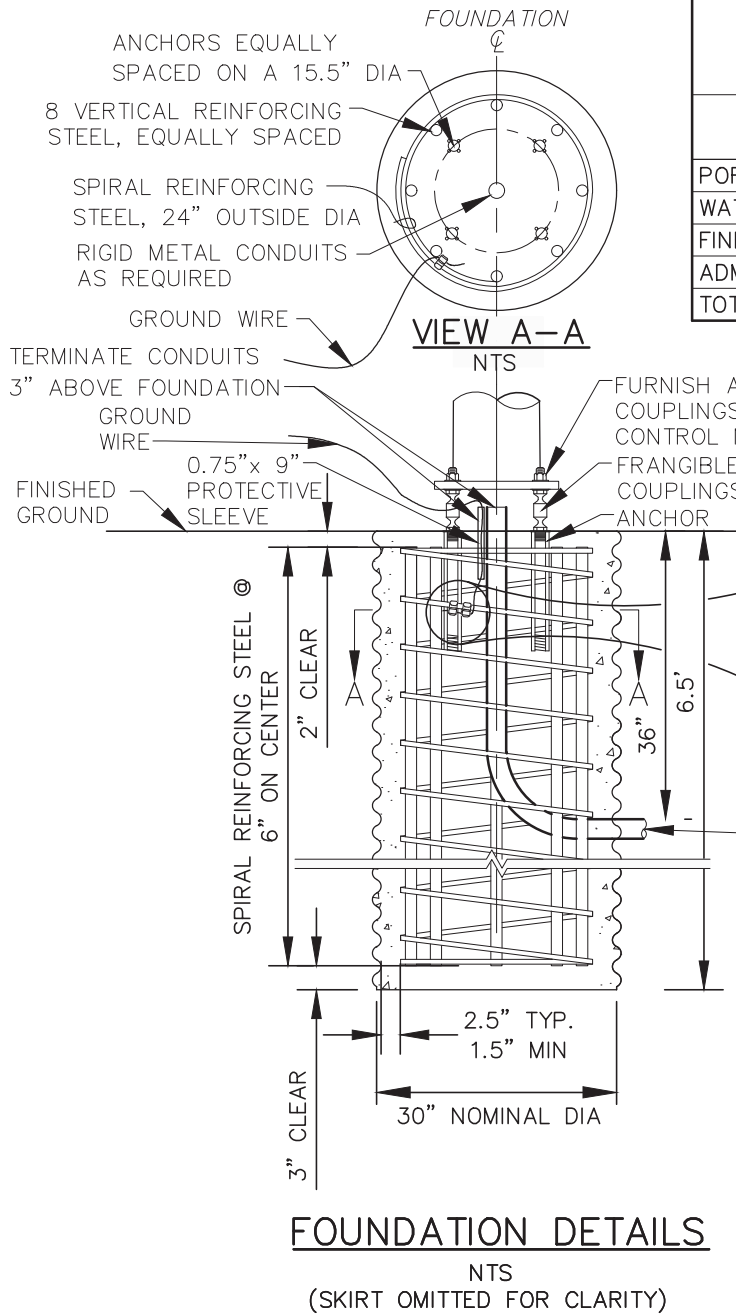
 MUNICIPALITY OF ANCHORAGE	SCALE: N.T.S. APPROVED: REVISED: 2/24	<h2 style="margin: 0;">SIGNAL POLE FOUNDATION NOTES CONCRETE 42" DIAMETER</h2>	SECTION # 80.05 DETAIL # 80-11
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NOTES:

NOTES ARE PROVIDED IN STANDARD DETAIL 80-12B.

MATERIAL REQUIREMENTS		
CONCRETE	CLASS A	$f'_c = 4000$ PSI
CMP	AASHTO M218	14 ga.
VERTICAL REINFORCING STEEL	AASHTO M31 #11	GR 60
SPIRAL REINFORCING STEEL	AASHTO M31 #5	GR 60
GROUND WIRE		#4 AWG
FRANGIBLE COUPLING	NCHRP 350 TL3 (SEE NOTE 9)	$V_u = 5.5$ KIPS $T_u = 43.2$ KIPS
CONDUIT	SCH 40	RMC
PROTECTIVE SLEEVE	SCH 40	PVC

CONTROLLED LOW STRENGTH MATERIAL MIX DESIGN	
ITEM	BATCHING QUANTITIES PER CY BATCH (LBS.)
PORTLAND CEMENT CONCRETE	188
WATER (52.1 GAL.)	435
FINE AGGREGATE SSD	3041
ADMIXTURE: AIR-ENTRAINMENT	2.0 OZ.
TOTAL	3664



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SCALE: N.T.S.
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CONCRETE FOUNDATION FOR BREAKAWAY SIGNAL POLE

SECTION # 80.04
DETAIL # 80-12A

DESIGN NOTES:

DESIGN STANDARD: 2013 STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS WITH 2019 INTERIM.

DESIGN LOAD: 1,000 LBS AXIAL, 2,000 LBS SHEAR, 50,000 FT-LBS MOMENT.

NOTES:

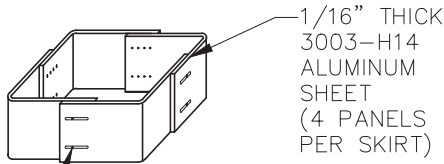
1. THIS FOUNDATION IS APPROVED FOR BREAKAWAY TRAFFIC SIGNAL APPLICATIONS IN COHESIONLESS SOILS WITH AN N1-60 VALUE OF 10 OR GREATER PER AASHTO T-206, "STANDARD PENETRATION TEST" (SPT). THIS FOUNDATION SHALL NOT BE USED IF ANY OF THE FOLLOWING ARE ENCOUNTERED; WATER TABLE ABOVE THE BOTTOM OF FOUNDATION, VERY LOOSE SOILS, ORGANIC SOILS, COHESIVE SOILS (CLAY), OR SOILS SUSCEPTIBLE TO FROST JACKING. IF ANY OF THESE CONDITIONS ARE ENCOUNTERED, STOP FOUNDATION WORK AND CONTACT THE ENGINEER.
2. PLACE FOUNDATION IN DRILLED OR EXCAVATED HOLE WITH CENTERLINE OF FOUNDATION LOCATED AT THE STATION, OFFSET, AND ELEVATION SPECIFIED IN PLANS. SET FOUNDATION TO SATISFY THE CONDITIONS DEPICTED IN CLEARANCE DETAIL.
3. FORM THE FOUNDATION IN CORRUGATED METAL PIPE CONFORMING TO M.A.S.S. DIVISION 80, ARTICLE 4.2.
4. PROVIDE 1.5 EXTRA TURNS AT EACH END OF THE SPIRAL REINFORCING STEEL. REINFORCING STEEL SHALL NOT BE SPLICED. TIE VERTICAL REINFORCING STEEL TO EACH INTERSECTION OF THE SPIRAL REINFORCING STEEL.
5. CONNECT GROUND WIRE NEAR THE TOP OF SPIRAL REINFORCING STEEL WITH TWO IRREVERSIBLE CONNECTORS AS SHOWN. FASTEN CONNECTORS ACCORDING TO THE MANUFACTURERS' RECOMMENDATIONS INCLUDING THE USE OF MANUFACTURER SPECIFIED TOOLS. THE GROUND WIRE MAY BE BARE SOLID, STRANDED, OR BRAIDED COPPER. PROTECT GROUND WIRE WITH PROTECTIVE SLEEVE AS SHOWN AND FILL WITH SILICON SEALANT.
6. COMPLETE ALL CONCRETE WORK IN CONFORMANCE WITH M.A.S.S. DIVISION 30 AND 80. USE A TUBE WITH A HOPPER HEAD OR OTHER APPROVED DEVICE WHEN DROPPING CONCRETE MORE THAN 5 FEET. VIBRATE CONCRETE DURING PLACEMENT BY MECHANICAL VIBRATION. ENSURE UPPER ANCHOR ROD THREADS ARE PROTECTED FROM CONTACT WITH CONCRETE DURING POUR.
7. BACKFILL AND COMPACT ACCORDING TO M.A.S.S. DIVISION 20 AND SECTION 80.04, ARTICLE 4.2 CAST-IN-PLACE CONCRETE FOUNDATION. USE SELECT BACKFILL OR CONTROLLED LOW STRENGTH MATERIAL AS BACKFILL MATERIAL. BATCH ITEMS FOR CONTROLLED LOW STRENGTH MATERIAL MIX SHALL CONFORM TO M.A.S.S. SECTION 30.01, ARTICLE 1.3 MATERIALS. ENSURE AREA BELOW FOUNDATION MEETS COMPACTION REQUIREMENTS AND IS FREE OF LOOSE MATERIAL AND DEBRIS PRIOR TO CONCRETE WORK.
8. INSTALL ALL ANCHORS ACCORDING TO THE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS. ANCHORS SHALL BE INSTALLED PLUMB. ANCHORS GREATER THAN 1:40 OUT-OF-PLUMB WILL RESULT IN FOUNDATION REJECTION.
9. THE FRANGIBLE COUPLING REFERENCED IS NCHRP 350 COMPLIANT. THERE IS NO MASH COMPLIANT DEVICE AVAILABLE AT THIS TIME.
10. SPECIAL GRADING DETAIL AND/OR SHIELDING MAY BE REQUIRED TO MAINTAIN 4" MAXIMUM CLEAR DISTANCE.
11. CONTROLLED LOW STRENGTH MATERIAL MIX DESIGN SHALL FOLLOW APPLICABLE SPECIFICATION OF M.A.S.S. DIVISION 30.

REVISION: 2024 M.A.S.S. UPDATE

 <p>MUNICIPALITY OF ANCHORAGE</p>	<p>SCALE: N.T.S.</p> <p>APPROVED:</p> <p>REVISED: 2/24</p>	<p>CONCRETE FOUNDATION NOTES</p> <p>BREAKAWAY SIGNAL POLE</p>	<p>SECTION # 80.04</p> <p>DETAIL # 80-12B</p>
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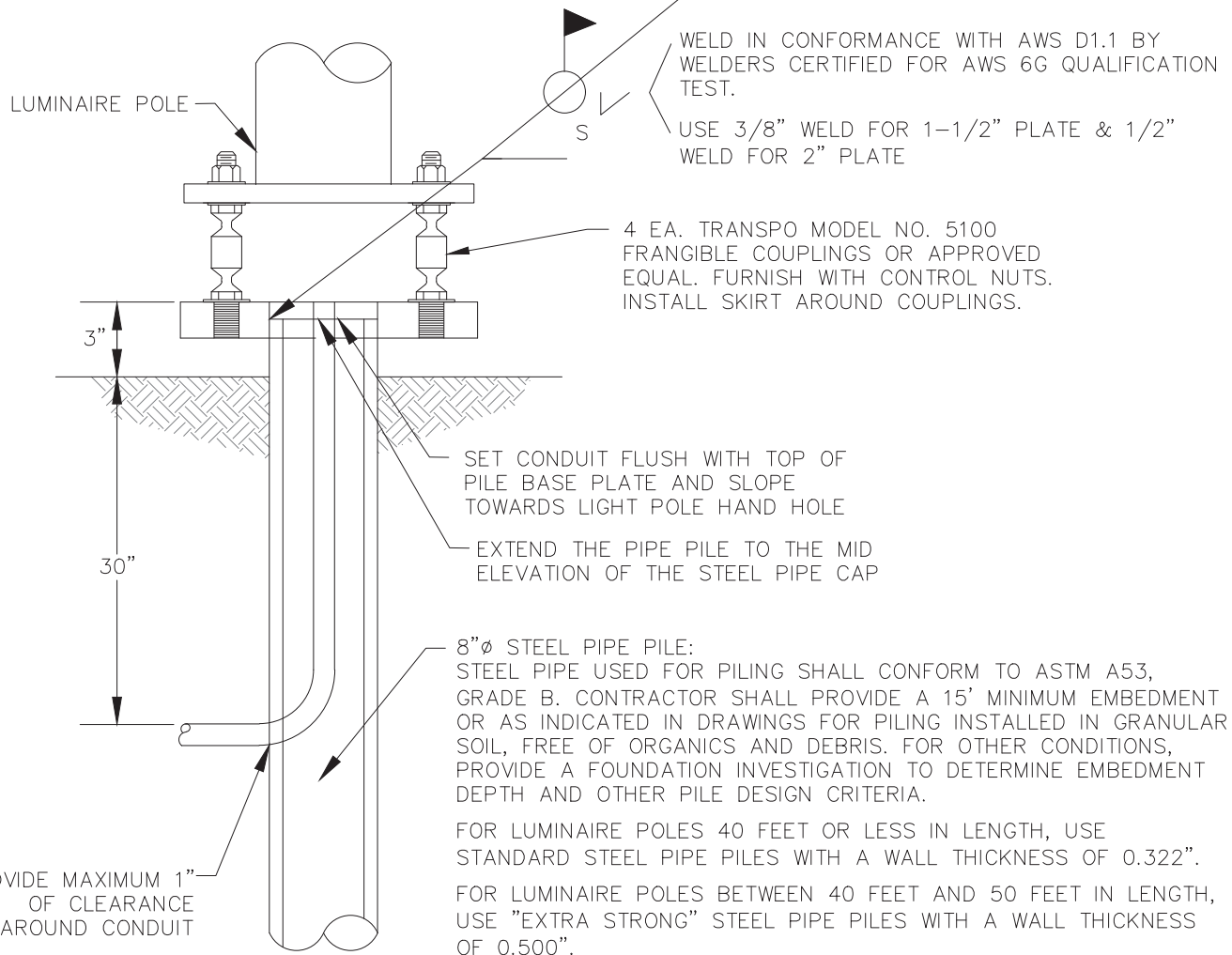
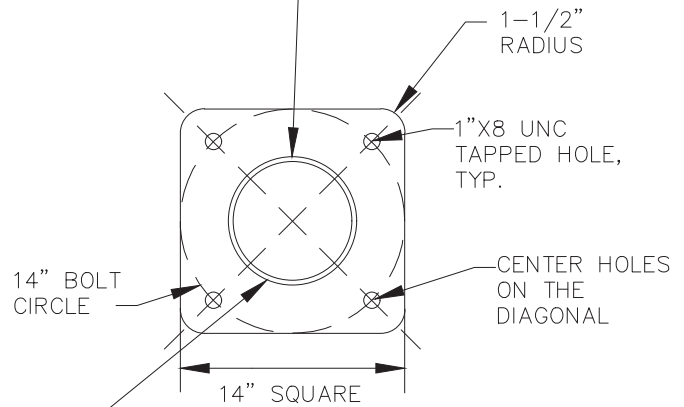
1. PROVIDE 1-1/2" THICK PLATE FOR LUMINAIRE POLES 40' AND LESS IN LENGTH. PROVIDE 2" THICK PLATES FOR LUMINAIRE POLES FROM 40 FEET TO 50 FEET IN LENGTH.
2. BOLT HOLES MAY BE DRILLED OR PLASMA CUT WITH MAXIMUM 1/8" LEAD-IN NOTCH.

PROVIDE 8-3/4" DIA. HOLE IN CENTER OF STEEL PILE CAP TO ALLOW STEEL PILE TO EXTEND TO THE MID ELEVATION OF THE STEEL PLATE.



ASSEMBLE SKIRT WITH EIGHT NO. 10 X 3/8" STAINLESS STEEL SHEET METAL SCREWS

SKIRT DETAIL



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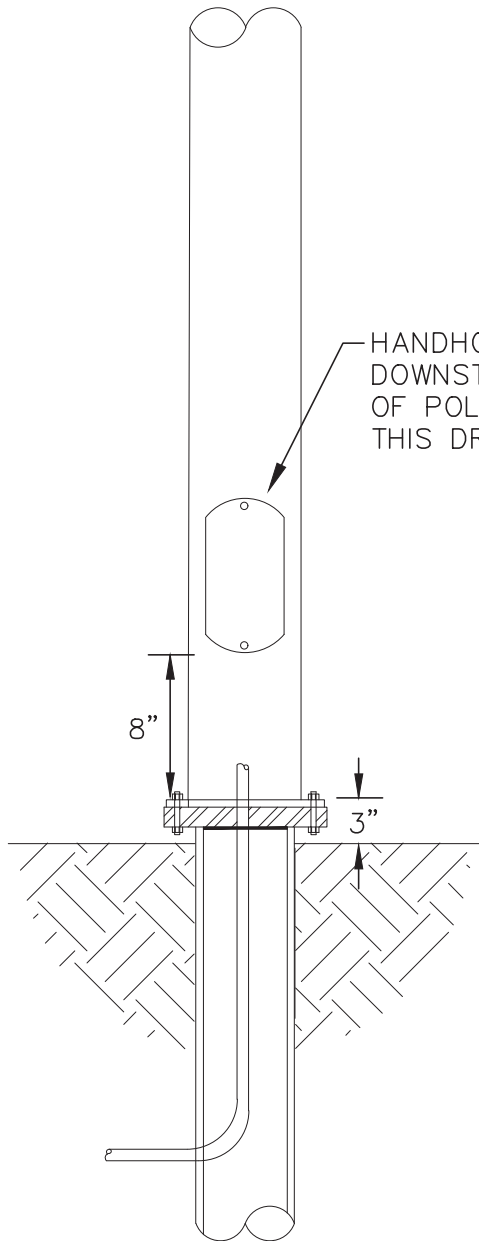
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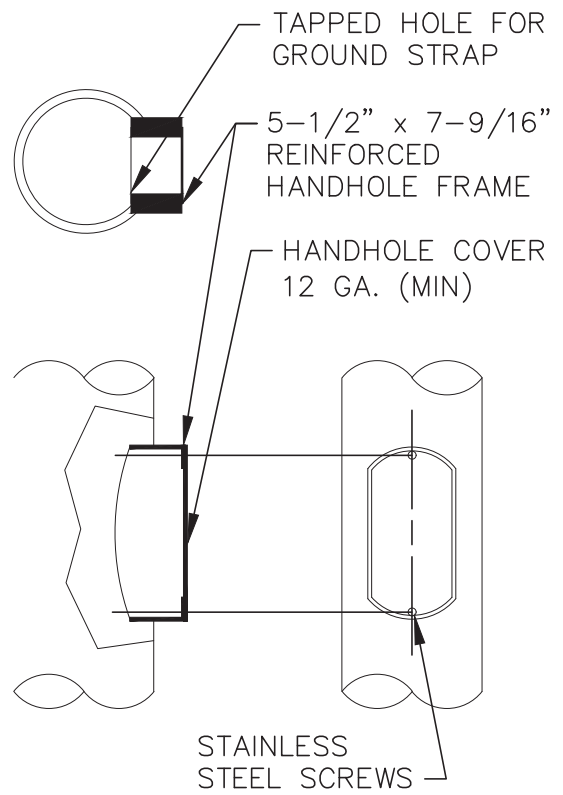
**DRIVEN PILE LUMINAIRE
POLE FOUNDATION
BREAKAWAY BASE**

SECTION #
80.04

DETAIL #
80-13



HANDHOLE. LOCATE ON
DOWNSTREAM TRAFFIC SIDE
OF POLE. SEE DETAIL A
THIS DRAWING.



DETAIL A

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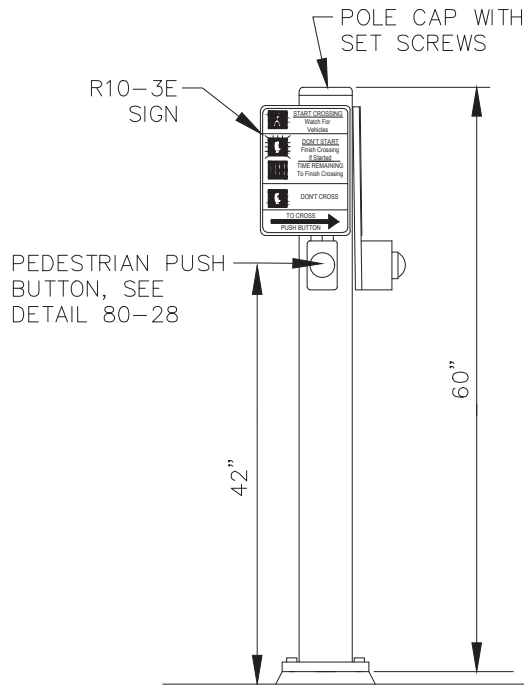
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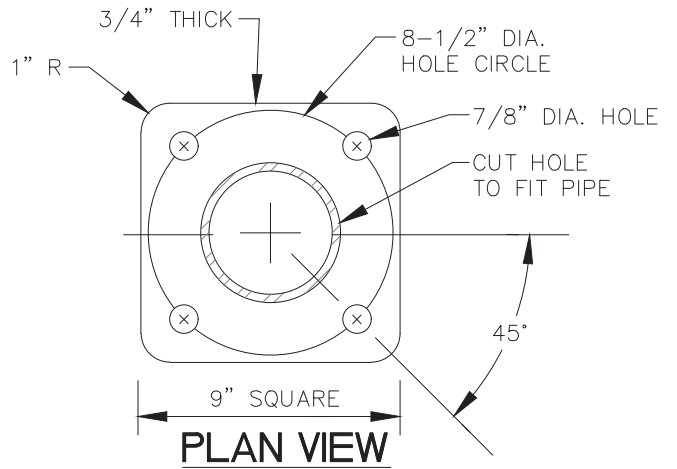
LUMINAIRE POLE HANDHOLD DETAILS

SECTION #
80.04

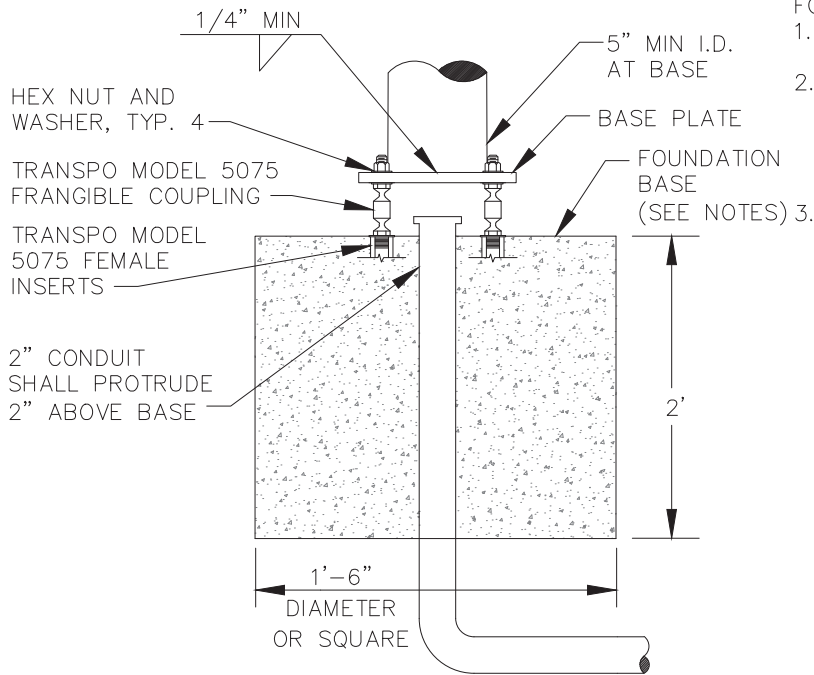
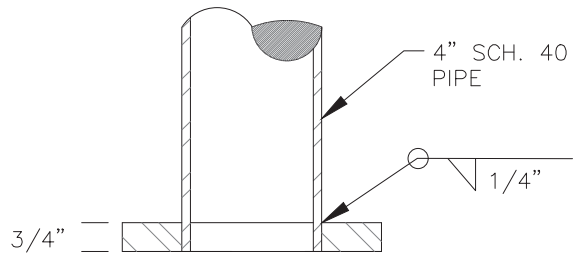
DETAIL #
80-14



POLE DETAIL



BASE PLATE DETAILS



5' PEDESTRIAN PUSH BUTTON FOUNDATION

FOUNDATION NOTES:

1. FOUNDATION BASE SHALL HAVE A BROOMED FINISH.
2. REFERENCE TOP BACK OF CURB IN ESTABLISHING FOUNDATION TOP ELEVATION. SET TOP OF FOUNDATION FLUSH WITH SIDEWALK/PAVING FINISH GRADE OR 2"-4" ABOVE FINISH GROUND ELEVATION.
3. IN FOUNDATIONS THAT LACK REINFORCING STEEL CAGES, INSTALL 21 FEET OF COILED #4 AWG, BARE, COPPER WIRE AS THE GROUNDING ELECTRODE. ROUTE THE CONDUCTOR TO PROTRUDE NEAR THE TOP, CENTER OF THE FOUNDATIONS. SLIDE A MINIMUM 6" LONG, PVC OR HDPE, PROTECTIVE SLEEVE OVER THE CONDUCTOR. ALLOW 1" OF THE SLEEVE AND 24" OF CONDUCTOR TO PROTRUDE FROM THE FOUNDATIONS.

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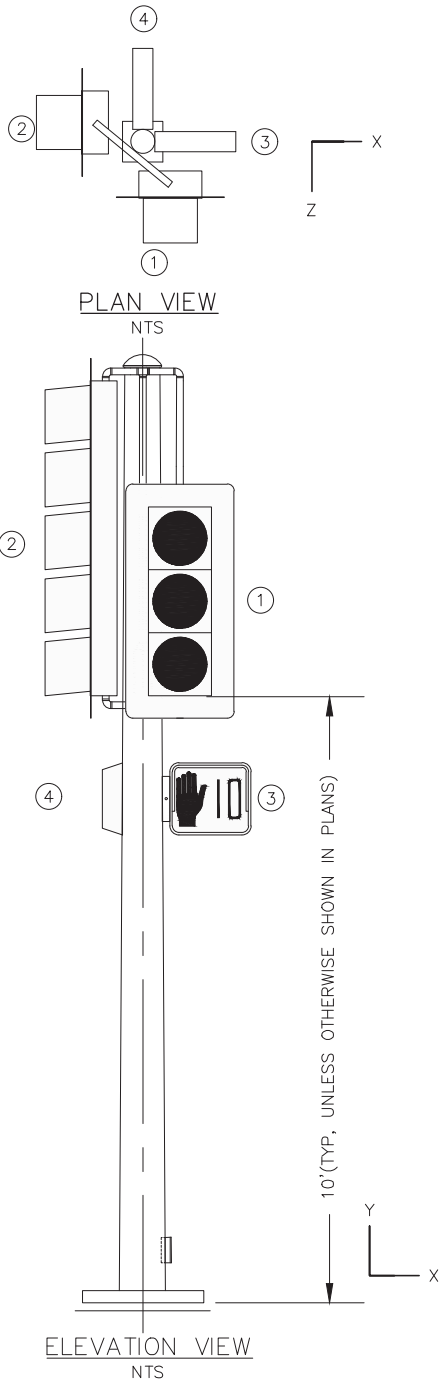


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**PEDESTRIAN PUSH BUTTON
POLE AND FOUNDATION**

SECTION #
80.04,
80.05

DETAIL #
80-15



NOTES:

1. DESIGN POLE ASSEMBLIES TO THE 2001 AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRE AND TRAFFIC SIGNALS, THE ALASKA STANDARD SPECIFICATIONS, STANDARD MODIFICATIONS, SPECIAL PROVISIONS AND THESE PLANS. DESIGN FOR A BASIC WIND SPEED OF 100 MPH, FATIGUE CATEGORY II.
2. POLES SHALL BE DESIGNED AND FABRICATED TO INCORPORATE ALL FIXED DESIGN ELEMENTS.
3. DESIGN AND FABRICATE TUBES FROM ONE PIECE OF TAPERED STEEL.
4. STEEL GREATER THAN 1/2" THICK SHALL CONFORM TO AASHTO M270 AND SHALL MEET THE FRACTURE CRITICAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS FOR ZONE 3.
5. INSTALL A 0.625" THICK 3003-H14 ALUMINUM SHEET SKIRT AROUND THE FRANGIBLE COUPLINGS FASTENED WITH STAINLESS SHEET METAL SCREWS.
6. THE DEPARTMENT WILL REJECT DAMAGED OR DEFECTIVE POLES FOR ANY OF THE FOLLOWING, INCLUDING BUT NOT LIMITED TO:
 - A. VARIANCES FROM APPROVED SHOP DRAWINGS.
 - B. VARIANCES FROM FIXED DESIGN ELEMENTS.
 - C. OUT OF ROUND. SECTIONS ARE OUT OF ROUND WHEN THE DIAMETERS OF ROUND MEMBERS EXCEED 2 PERCENT OF THE DIMENSION SPECIFIED ON THE SHOP DRAWINGS.
 - D. BOWED WITH SWEEPS EXCEEDING 0.75" INCH THROUGHOUT THE LENGTH OF THE POLE, MASTARM, OR SEGMENT.
 - E. DAMAGED OR DENTED FINISHES.
7. WELD SIZE TO BE DETERMINED BY MANUFACTURER.
8. PROVIDE PERMANENT TAGS PER MASS DIVISION 80, ARTICLE 5.6.
9. THIS DRAWING IS INTENDED FOR POLE DESIGN PURPOSES ONLY. ASSEMBLY CONFIGURATIONS ARE FOR LOADING PURPOSES AND MAY DIFFER FROM THOSE SHOWN IN PLANS. POLES HAVE NOT BEEN EVALUATED FOR LOADING CONDITIONS MORE SEVERE THAN THOSE SHOWN AND WILL REQUIRE INDIVIDUAL ANALYSIS WHEN ENCOUNTERED.

SEE MASS DETAIL 80-16B
FOR ADDITIONAL DETAILS

POLE DESIGN LOADING		
LOAD COMPONENT	EFFECTIVE AREA SQ. FT.	WEIGHT LBS.
1 = SIGNAL	7	60
2 = SIGNAL	11	100
3 = PED HEAD	2.5	25
4 = PED HEAD	2.5	25

FIXED DESIGN ELEMENTS	
ALL ASSEMBLIES	
LENGTH	10'(TYP, MAY VARY IN PLANS)
FIXED END DIAMETER O.D.	10.0"
TAPER	0.14" /FT
TUBE THICKNESS	7 GA.
HAND-HOLE O.D.	5.63" X 7.31"
BASE PLATE	15.5" X 15.5" X 1.375"
BOLT CIRCLE	15.5"
MATERIAL PROPERTIES	
TUBE	ASTM A572 GR. 55
BASEPLATE	AASHTO M270 F3, GR 50
TOP PLATE	ASTM A36
HANDHOLE REINFORCEMENT	ASTM A53, GR. B
FINISH	AASHTO M111 & M232

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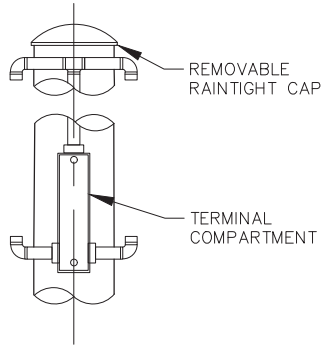
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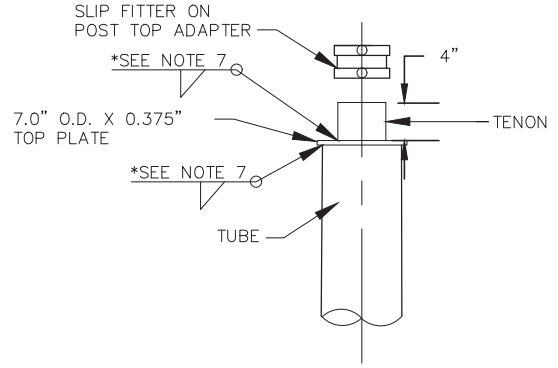
10' BREAKAWAY SIGNAL POLE

SECTION #
80.05

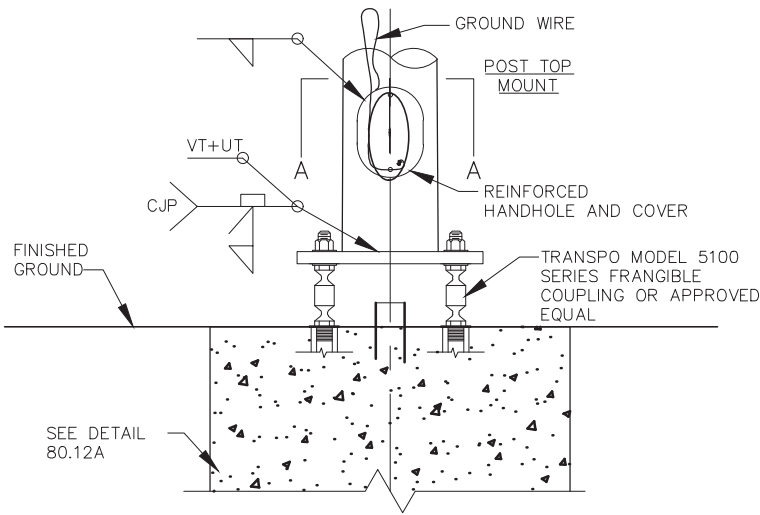
DETAIL #
80-16A



SIDE MOUNT DETAIL

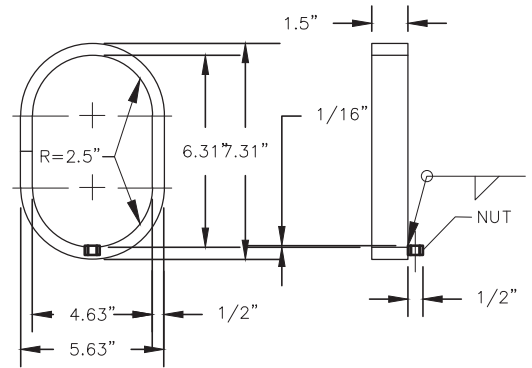


TOP MOUNT DETAIL



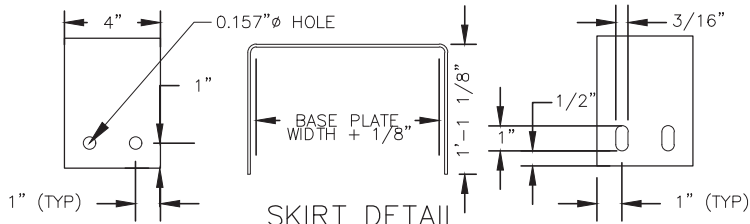
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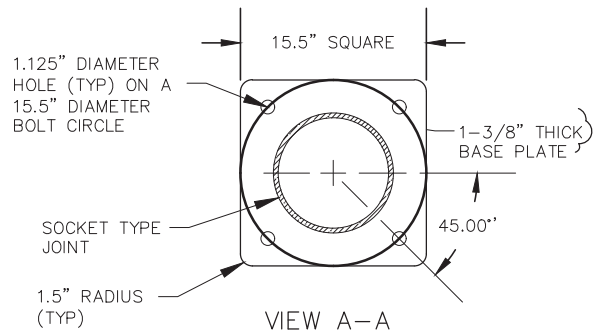
HANDHOLE DETAIL

NTS



SKIRT DETAIL

NTS
(TWO REQUIRED PER POLE)



VIEW A-A
PLAN VIEW OF BASE PLATE
NTS

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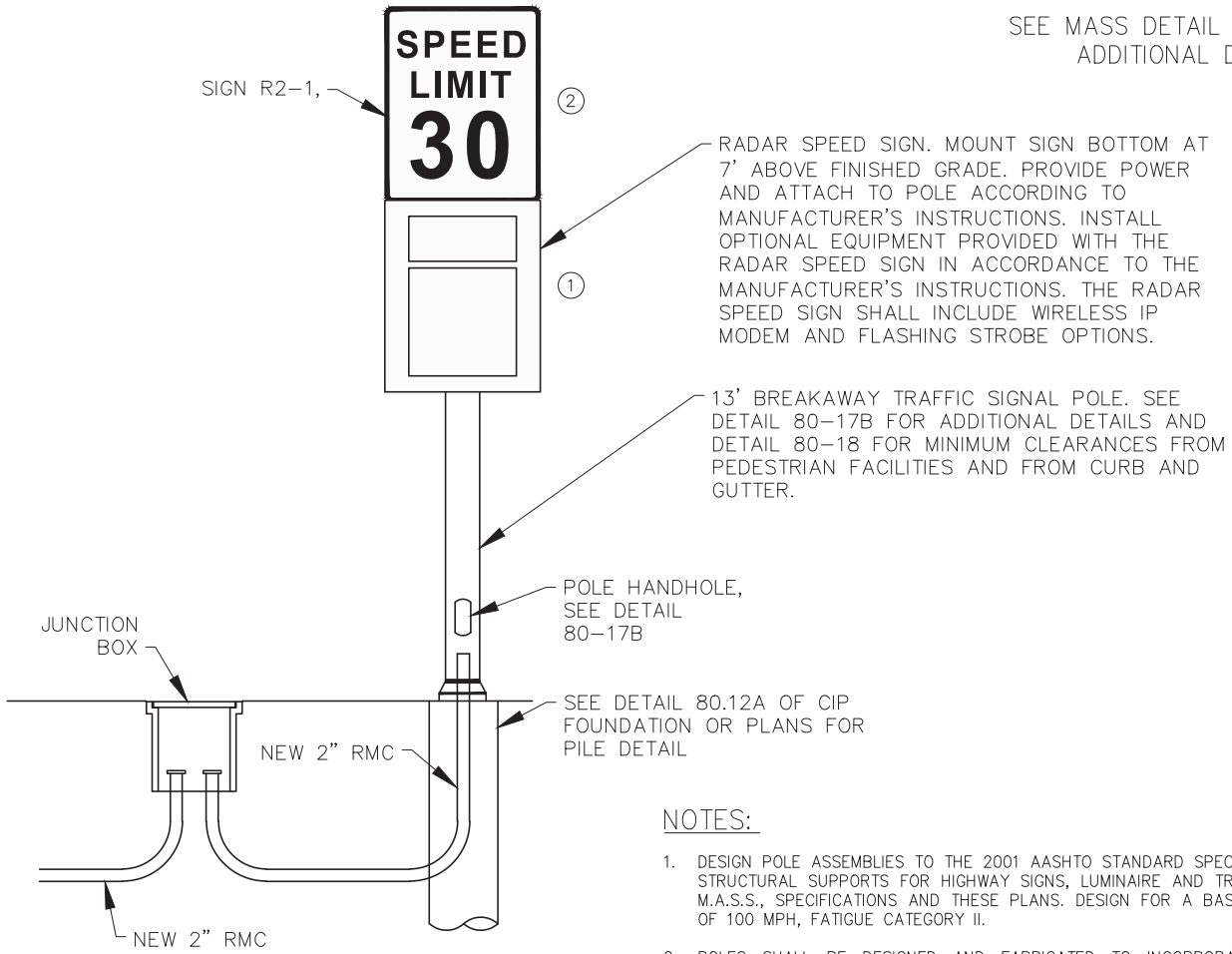
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10' BREAKAWAY SIGNAL POLE DETAILS

SECTION #
80.05

DETAIL #
80-16B

SEE MASS DETAIL 80-17B FOR ADDITIONAL DETAILS



NOTES:

- DESIGN POLE ASSEMBLIES TO THE 2001 AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRE AND TRAFFIC SIGNALS, M.A.S.S., SPECIFICATIONS AND THESE PLANS. DESIGN FOR A BASIC WIND SPEED OF 100 MPH, FATIGUE CATEGORY II.
- POLES SHALL BE DESIGNED AND FABRICATED TO INCORPORATE ALL FIXED DESIGN ELEMENTS.
- DESIGN AND FABRICATE TUBES FROM ONE PIECE OF TAPERED STEEL.
- STEEL GREATER THAN 1/2" THICK SHALL CONFORM TO AASHTO M270 AND SHALL MEET THE FRACTURE CRITICAL CHARPY V-NOTCH IMPACT TEST REQUIREMENTS FOR ZONE 3.
- INSTALL A 0.625" THICK 3003-H14 ALUMINUM SHEET SKIRT AROUND THE FRANGIBLE COUPLINGS FASTENED WITH STAINLESS SHEET METAL SCREWS.
- THE TRAFFIC ENGINEERING DEPARTMENT WILL REJECT DAMAGED OR DEFECTIVE POLES FOR ANY OF THE FOLLOWING, INCLUDING BUT NOT LIMITED TO;
 - VARIANCES FROM APPROVED SHOP DRAWINGS.
 - VARIANCES FROM FIXED DESIGN ELEMENTS.
 - OUT OF ROUND. SECTIONS ARE OUT OF ROUND WHEN THE DIAMETERS OF ROUND MEMBERS EXCEED 2 PERCENT OF THE DIMENSION SPECIFIED ON THE SHOP DRAWINGS.
 - BOWED WITH SWEEPS EXCEEDING 0.75" INCH THROUGHOUT THE LENGTH OF THE POLE, MASTARM, OR SEGMENT.
 - DAMAGED OR DENTED FINISHES.
- WELD SIZE TO BE DETERMINED BY MANUFACTURER.
- PROVIDE PERMANENT TAGS PER M.A.S.S. DIVISION 80, ARTICLE 5.6.
- THIS DRAWING IS INTENDED FOR POLE DESIGN PURPOSES ONLY. ASSEMBLY CONFIGURATIONS ARE FOR LOADING PURPOSES AND MAY DIFFER FROM THOSE SHOWN IN PLANS. POLES HAVE NOT BEEN EVALUATED FOR LOADING CONDITIONS MORE SEVERE THAN THOSE SHOWN AND WILL REQUIRE INDIVIDUAL ANALYSIS WHEN ENCOUNTERED.
- TERMINATE CONDUIT 3" ABOVE THE TOP OF THE ANCHOR PLATE. INSTALL A GROUNDING BUSHING ON THE END OF THE CONDUIT AND BOND TO THE ANCHOR PLATE.

POLE DESIGN LOADING

LOAD COMPONENT	EFFECTIVE AREA SQ. FT.	WEIGHT LBS.
1 = RADAR SIGN	9	42
2 = SIGN	5	-

FIXED DESIGN ELEMENTS

ALL ASSEMBLIES	
LENGTH	13' (TYP, MAY VARY IN PLANS)
FIXED END DIAMETER O.D.	10.0"
TAPER	0.14" / FT
TUBE THICKNESS	7 GA.
HAND-HOLE O.D.	5.63" X 7.31"
BASE PLATE	15.5" X 15.5" X 1.375"
BOLT CIRCLE	15.5"
FRANGIBLE BASE	MODEL 5100 POLE SAFE OR APPROVED EQUAL
MATERIAL PROPERTIES	
TUBE	ASTM A572 GR. 55
BASEPLATE	AASHTO M270 F3, GR 50
TOP PLATE	ASTM A36
HANDHOLE REINFORCEMENT	ASTM A53, GR. B
FINISH	AASHTO M111 & M232

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

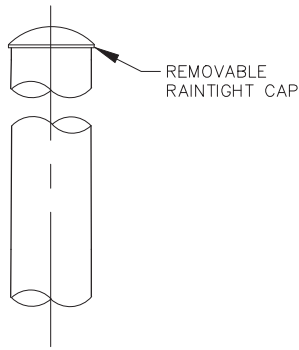
APPROVED:

REVISED:
2/24

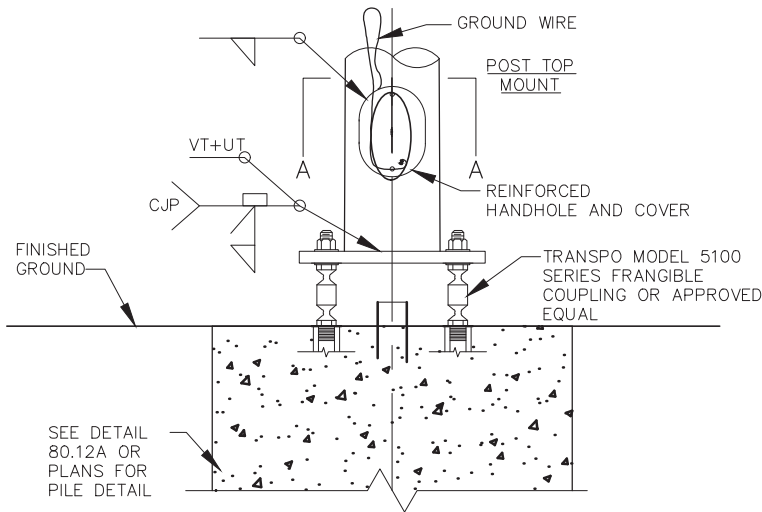
**RADAR SPEED SIGN
BREAKAWAY POLE**

SECTION #
80.05/80.29

DETAIL #
80-17A

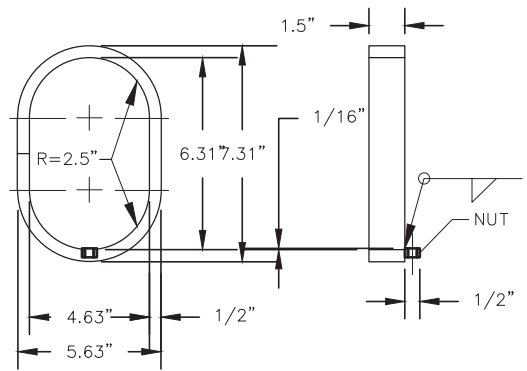


POLE TOP DETAIL



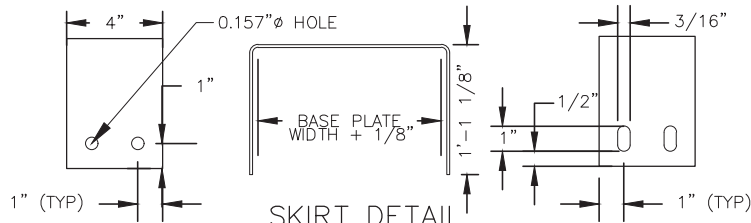
SIGNAL POST AND BASE

NTS



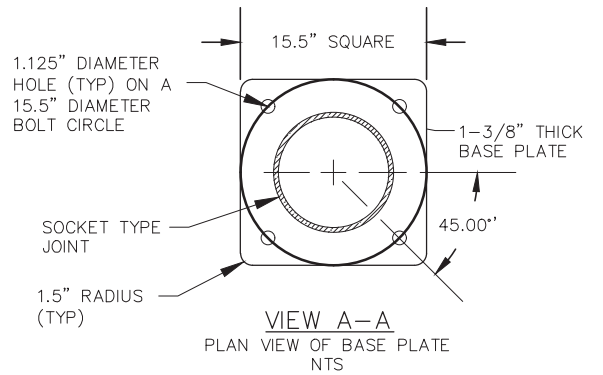
HANDHOLE DETAIL

NTS



SKIRT DETAIL

NTS
(TWO REQUIRED PER POLE)



REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

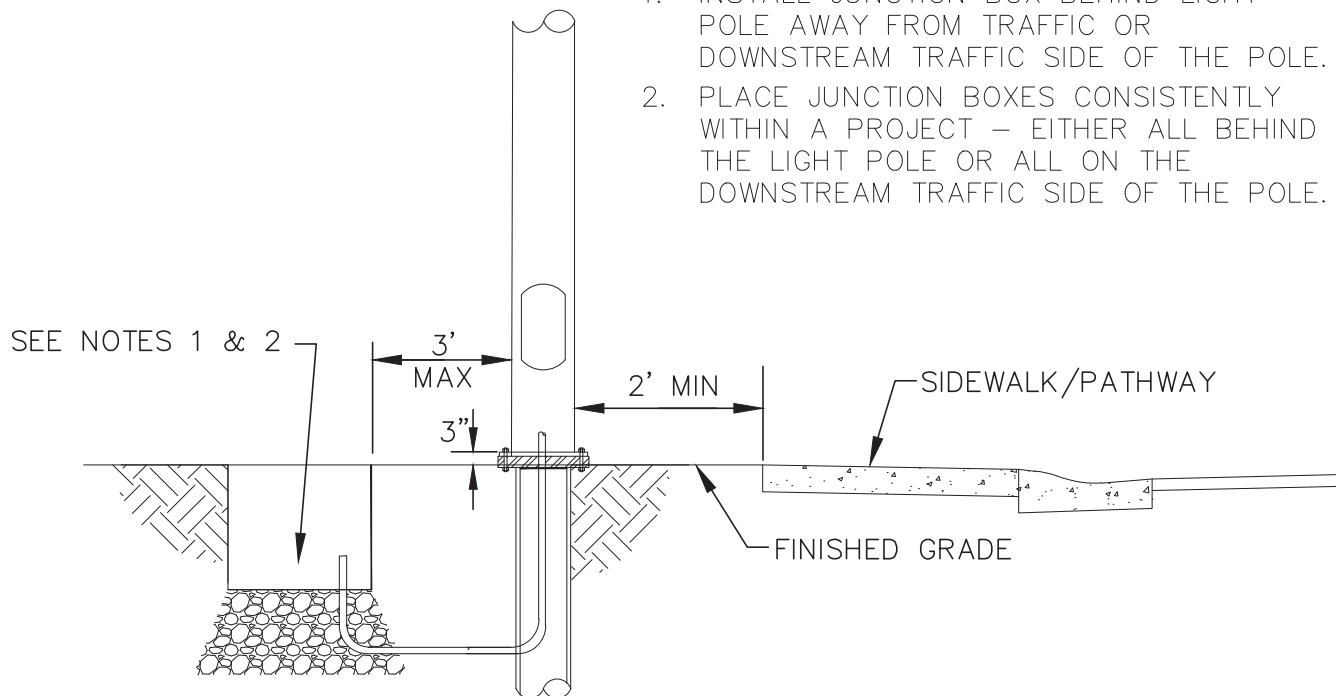
RADAR SPEED SIGN BREAKAWAY POLE DETAILS

SECTION #
80.05

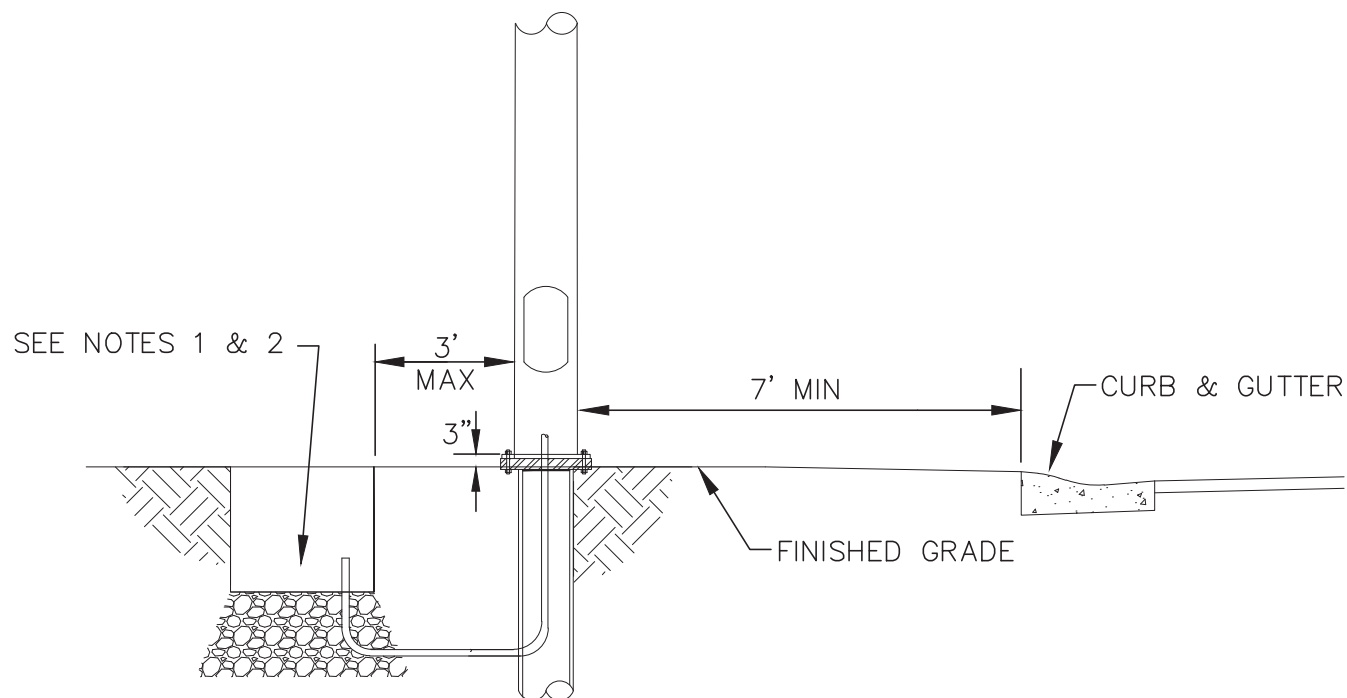
DETAIL #
80-17B

NOTES:

1. INSTALL JUNCTION BOX BEHIND LIGHT POLE AWAY FROM TRAFFIC OR DOWNSTREAM TRAFFIC SIDE OF THE POLE.
2. PLACE JUNCTION BOXES CONSISTENTLY WITHIN A PROJECT – EITHER ALL BEHIND THE LIGHT POLE OR ALL ON THE DOWNSTREAM TRAFFIC SIDE OF THE POLE.



CLEARANCES WITH PEDESTRIAN FACILITIES



CLEARANCES WITHOUT PEDESTRIAN FACILITIES

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

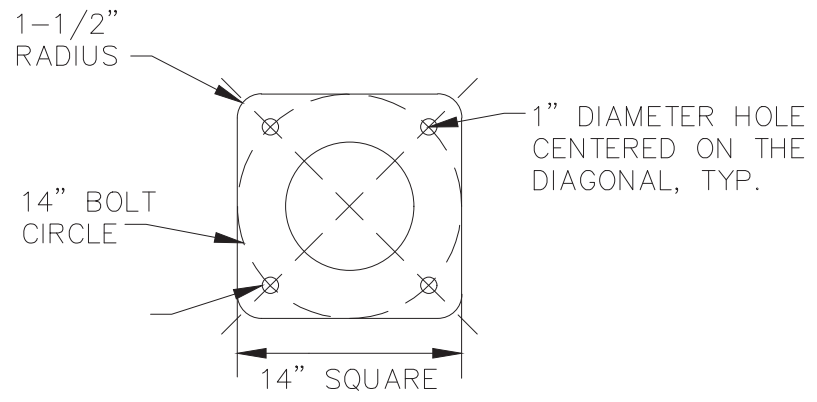
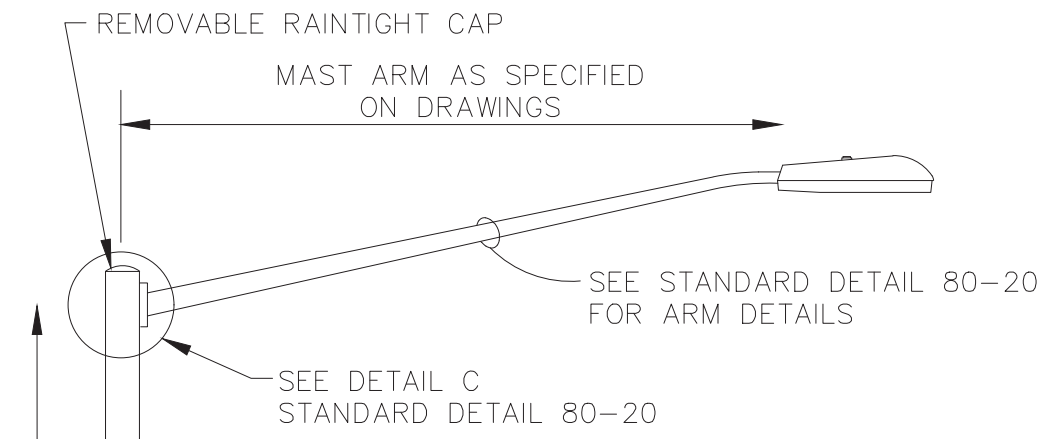
APPROVED:

REVISED:
2/24

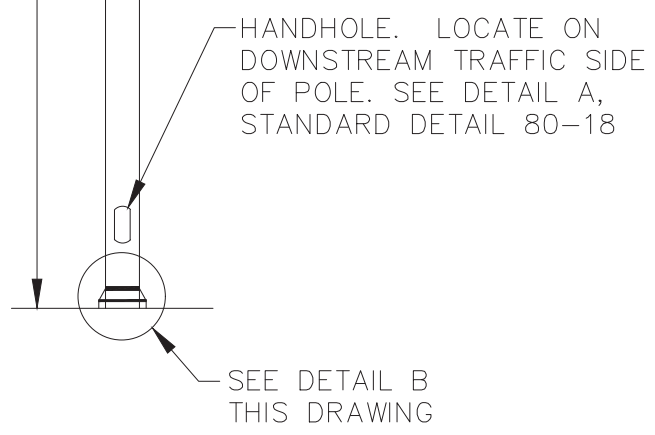
LUMINAIRE CLEARANCES

SECTION #
80.08

DETAIL #
80-18



DETAIL B



LUMINAIRE POLE DATA			
POLE LENGTH (H)	O.D. (MIN.)		U.S.S. GAGE
	BASE	TOP	
25' to 30'	8"	3-7/8"	10
+30' to 35'	8-3/4"	3-7/8"	10
+35' to 40'	9"	3-7/8"	10
+40' to 45'	9-1/2"	3-7/8"	10
+45' to 50'	10"	3-7/8"	10

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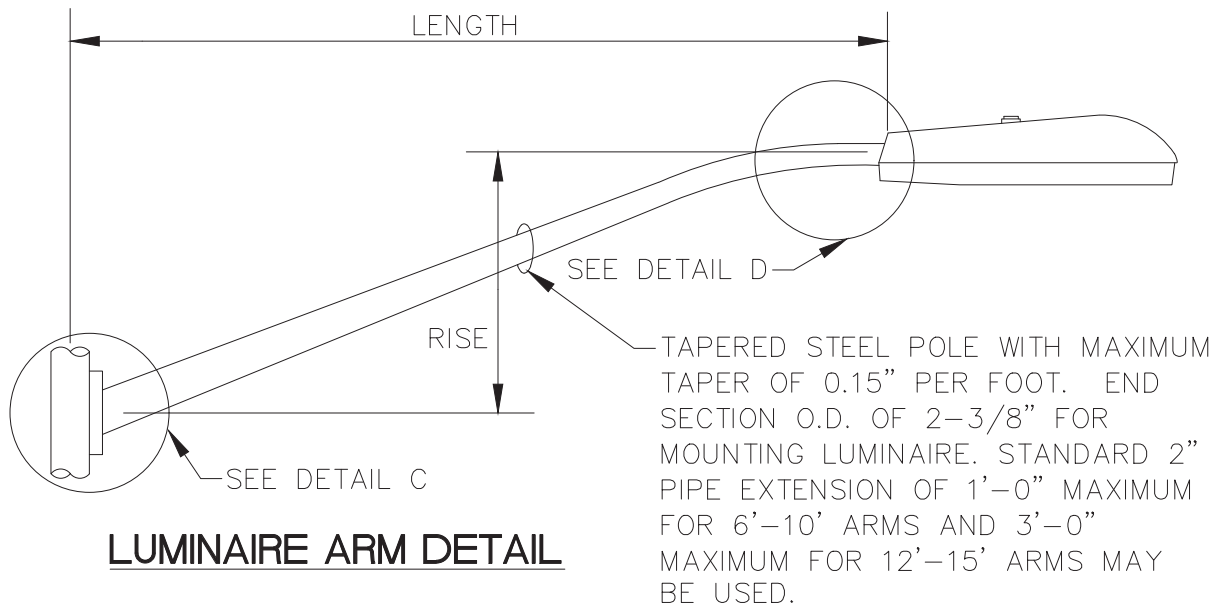
MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

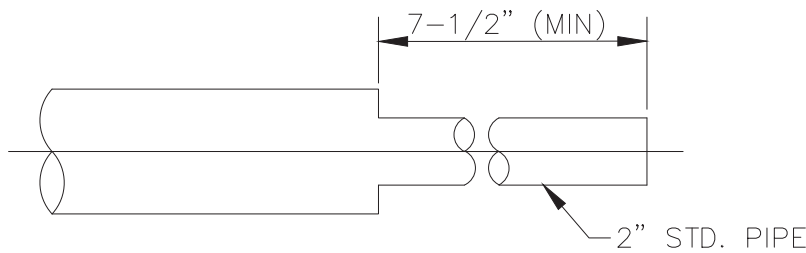
FLANGE-MOUNTED LUMINAIRE POLE

SECTION #
80.05
 DETAIL #
80-19



LUMINAIRE ARM DETAIL

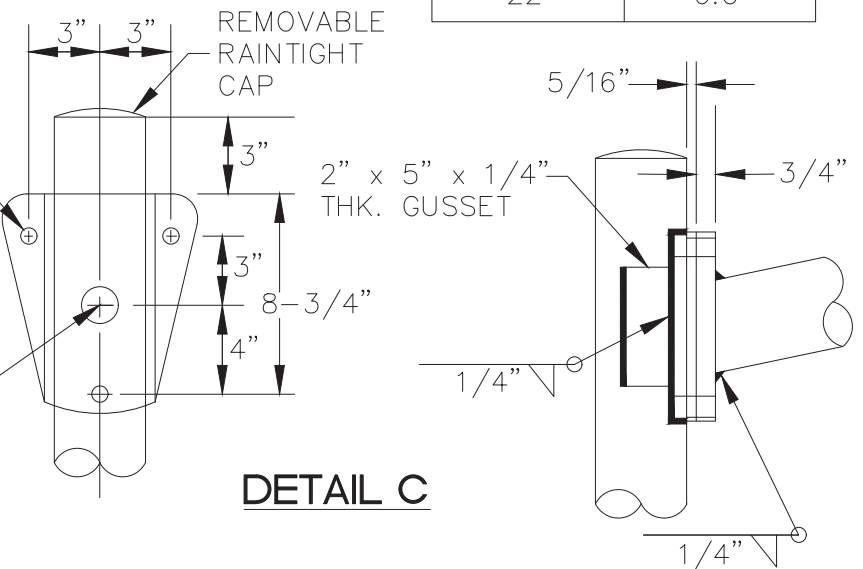
LENGTH	RISE
6'	1.5'
8'	2.2'
10'	2.5'
12'	3.6'
15'	4.3'
22'	6.0'



DETAIL D

3 EA. 3/4"-10 TAP. POLE PLATE FOR 3/4" BOLTS. BOLTS SHALL CONFORM TO ASTM A325 AND GALVANIZED IN ACCORDANCE WITH ASTM A135.

2" CHASED OUTLET FOR ELECTRICAL CONDUCTORS



DETAIL C

REVISION: 2024 M.A.S.S. UPDATE



SCALE:
N.T.S.

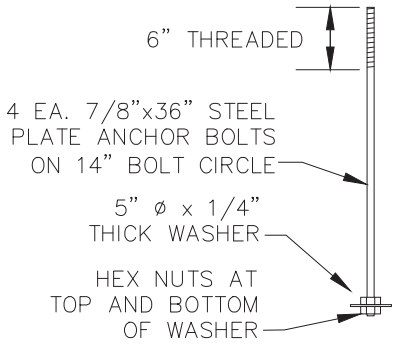
APPROVED:

REVISED:
2/24

**LUMINAIRE ARM
DETAIL**

SECTION #
80.05

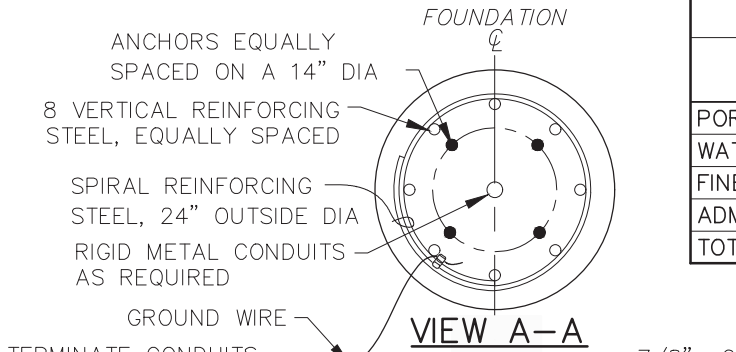
DETAIL #
80-20



ANCHOR DETAIL

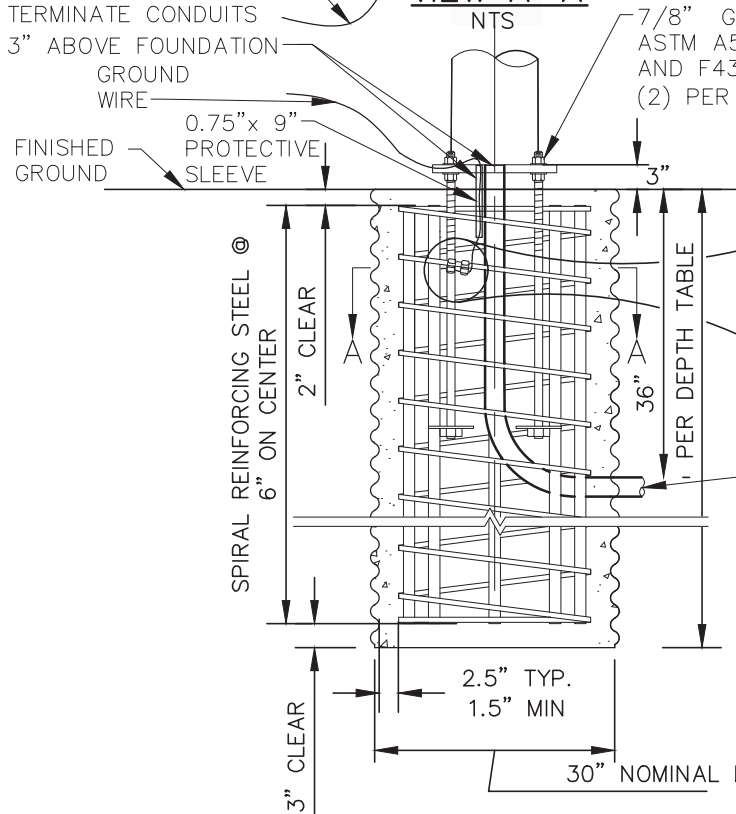
MATERIAL REQUIREMENTS		
CONCRETE	CLASS A	$f'_c = 4000$ PSI
CMP	AASHTO M218	14 ga.
VERTICAL REINFORCING STEEL	AASHTO M31 #11	GR 60
SPIRAL REINFORCING STEEL	AASHTO M31 #5	GR 60
GROUND WIRE		#4 AWG
ANCHOR BOLT	ASTM F1554	GR 55
CONDUIT	SCH 40	RMC
PROTECTIVE SLEEVE	SCH 40	PVC

CONTROLLED LOW STRENGTH MATERIAL MIX DESIGN	
ITEM	BATCHING QUANTITIES PER CY BATCH (LBS.)
PORTLAND CEMENT CONCRETE	188
WATER (52.1 GAL.)	435
FINE AGGREGATE SSD	3041
ADMIXTURE: AIR-ENTRAINMENT	2.0 OZ.
TOTAL	3664



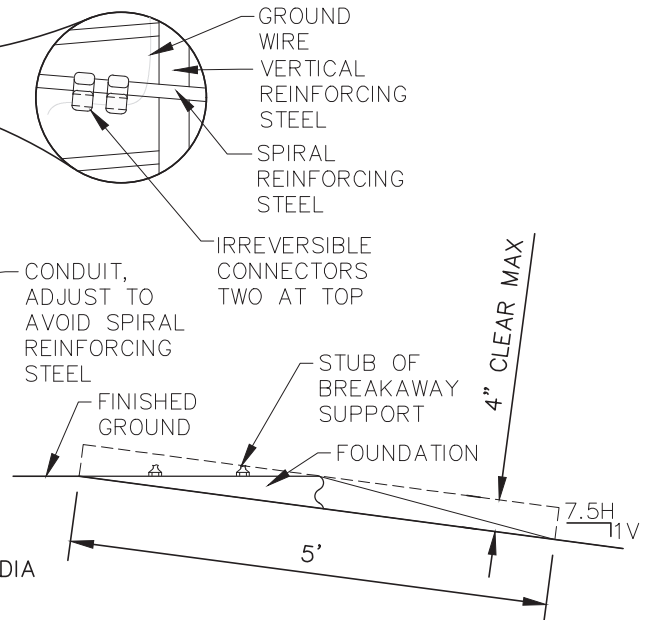
VIEW A-A

NOTES:
NOTES ARE PROVIDED IN STANDARD DETAIL 80-23.



FOUNDATION DETAILS

NTS
(SKIRT OMITTED FOR CLARITY)



CLEARANCE DETAIL

NTS
(SEE NOTE 10)

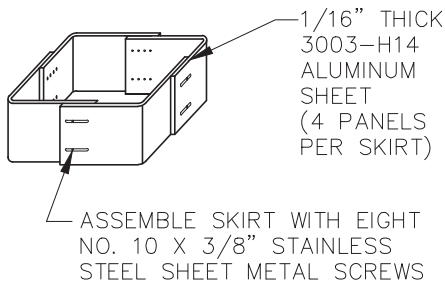
REVISION: 2024 M.A.S.S. UPDATE



SCALE:
N.T.S.
APPROVED:
REVISED:
2/24

**CONCRETE FOUNDATION FOR
FIXED BASE
LUMINAIRE POLE**

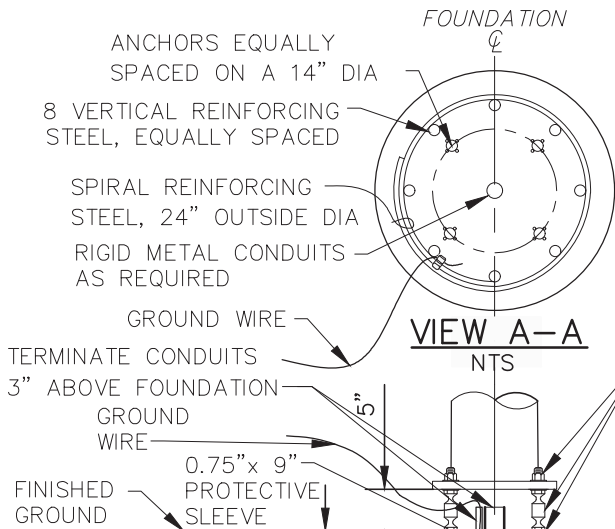
SECTION #
80.04
DETAIL #
80-21



SKIRT DETAIL

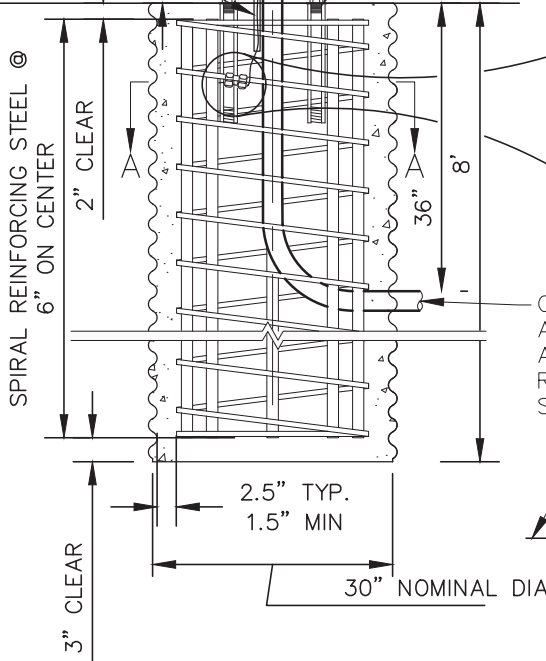
MATERIAL REQUIREMENTS		
CONCRETE	CLASS A	$f'_c = 4000$ PSI
CMP	AASHTO M218	14 ga.
VERTICAL REINFORCING STEEL	AASHTO M31 #11	GR 60
SPIRAL REINFORCING STEEL	AASHTO M31 #5	GR 60
GROUND WIRE		#4 AWG
FRANGIBLE COUPLING	NCHRP 350 TL3 (SEE NOTE 9)	$V_u = 5.5$ KIPS $T_u = 43.2$ KIPS
CONDUIT	SCH 40	RMC
PROTECTIVE SLEEVE	SCH 40	PVC

CONTROLLED LOW STRENGTH MATERIAL MIX DESIGN	
ITEM	BATCHING QUANTITIES PER CY BATCH (LBS.)
PORTLAND CEMENT CONCRETE	188
WATER (52.1 GAL.)	435
FINE AGGREGATE SSD	3041
ADMIXTURE: AIR-ENTRAINMENT	2.0 OZ.
TOTAL	3664



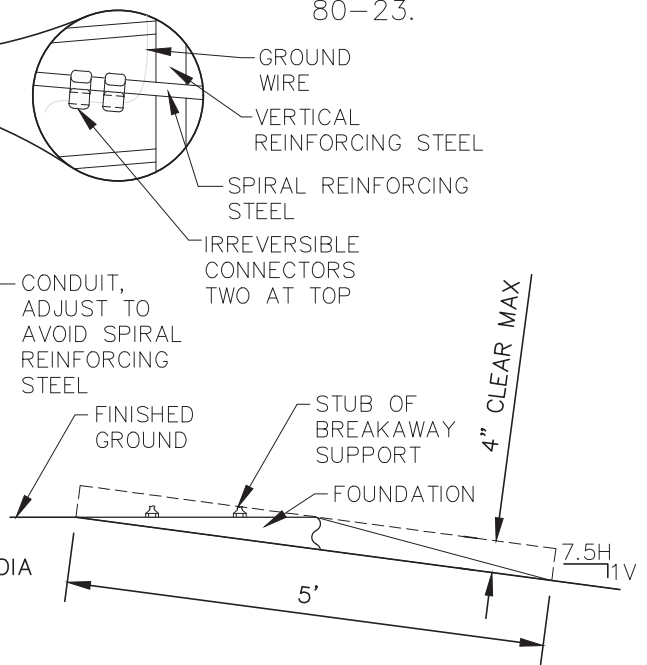
4 EA. TRANSPO MODEL NO. 5100 FRANGIBLE COUPLINGS AND TRANSPO TYPE B FEMALE ANCHORS, OR APPROVED EQUAL. FURNISH WITH CONTROL NUTS.

NOTES:
NOTES ARE PROVIDED IN STANDARD DETAIL 80-23.



FOUNDATION DETAILS

NTS
(SKIRT OMITTED FOR CLARITY)



CLEARANCE DETAIL

NTS
(SEE NOTE 10)

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY OF ANCHORAGE

SCALE: N.T.S.

APPROVED:

REVISED: 2/24

CONCRETE FOUNDATION FOR BREAKAWAY BASE LUMINAIRE POLE

SECTION # 80.04

DETAIL # 80-22

DESIGN NOTES:

DESIGN STANDARD: 2013 STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS WITH 2019 INTERIM.

DESIGN LOAD: 1,000 LBS AXIAL, 2,000 LBS SHEAR, 50,000 FT-LBS MOMENT.

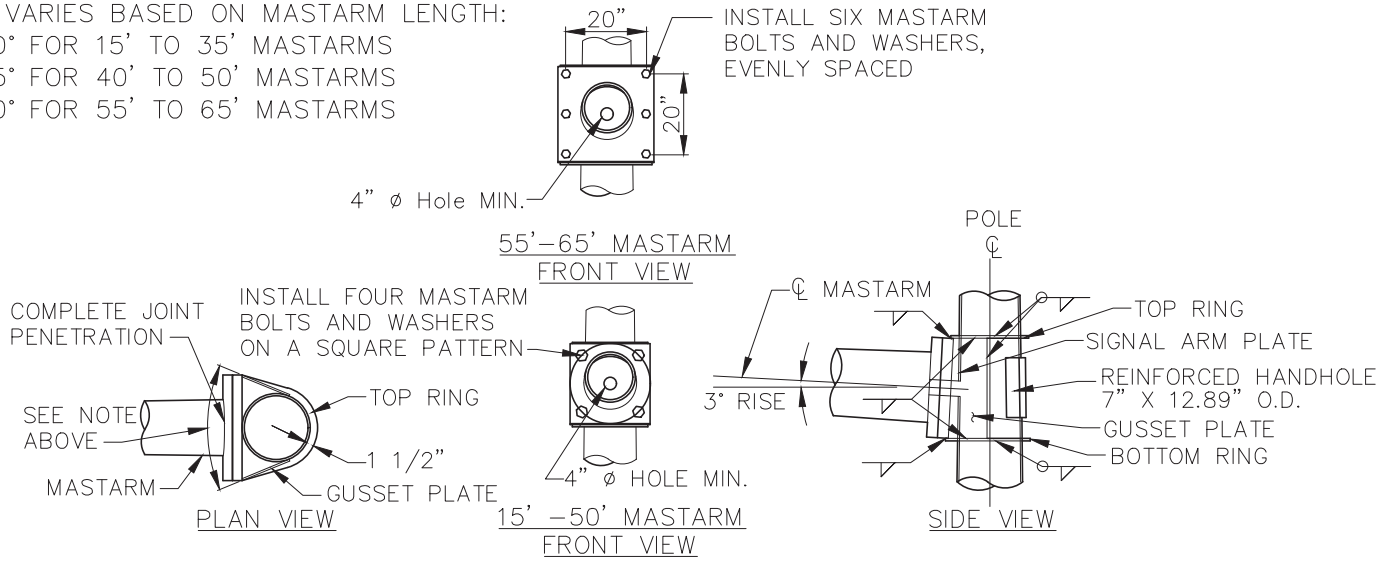
NOTES:

1. THIS FOUNDATION IS APPROVED FOR ELECTROLIER APPLICATIONS IN COHESIONLESS SOILS WITH AN N1-60 VALUE OF 10 OR GREATER PER AASHTO T-206, "STANDARD PENETRATION TEST" (SPT). THIS FOUNDATION SHALL NOT BE USED IF ANY OF THE FOLLOWING ARE ENCOUNTERED; WATER TABLE ABOVE THE BOTTOM OF FOUNDATION, VERY LOOSE SOILS, ORGANIC SOILS, COHESIVE SOILS (CLAY), OR SOILS SUSCEPTIBLE TO FROST JACKING. IF ANY OF THESE CONDITIONS ARE ENCOUNTERED, STOP FOUNDATION WORK AND CONTACT THE ENGINEER.
2. PLACE THE FOUNDATION IN DRILLED OR EXCAVATED HOLE WITH CENTERLINE OF FOUNDATION LOCATED AT THE STATION, OFFSET, AND ELEVATION SPECIFIED IN PLANS. SET FOUNDATION TO SATISFY THE CONDITIONS DEPICTED IN THE CLEARANCE DETAIL.
3. FORM THE FOUNDATION IN CORRUGATED METAL PIPE CONFORMING TO M.A.S.S. DIVISION 80, ARTICLE 4.2.
4. PROVIDE 1.5 EXTRA TURNS AT EACH END OF THE SPIRAL REINFORCING STEEL. REINFORCING STEEL SHALL NOT BE SPLICED. TIE VERTICAL REINFORCING STEEL TO EACH INTERSECTION OF THE SPIRAL REINFORCING STEEL.
5. CONNECT GROUND WIRE NEAR THE TOP OF SPIRAL REINFORCING STEEL WITH TWO IRREVERSIBLE CONNECTORS AS SHOWN. FASTEN CONNECTORS ACCORDING TO THE MANUFACTURERS' RECOMMENDATIONS INCLUDING THE USE OF MANUFACTURER SPECIFIED TOOLS. THE GROUND WIRE MAY BE BARE SOLID, STRANDED, OR BRAIDED COPPER. PROTECT GROUND WIRE WITH PROTECTIVE SLEEVE AS SHOWN AND FILL WITH SILICON SEALANT.
6. COMPLETE ALL CONCRETE WORK IN CONFORMANCE WITH M.A.S.S. DIVISION 30 AND 80. USE A TUBE WITH A HOPPER HEAD OR OTHER APPROVED DEVICE WHEN DROPPING CONCRETE MORE THAN 5 FEET. VIBRATE CONCRETE DURING PLACEMENT BY MECHANICAL VIBRATION. ENSURE UPPER ANCHOR ROD THREADS ARE PROTECTED FROM CONTACT WITH CONCRETE DURING POUR.
7. BACKFILL AND COMPACT ACCORDING TO M.A.S.S. DIVISION 20 AND SECTION 80.04, ARTICLE 4.2 CAST-IN-PLACE CONCRETE FOUNDATION. USE SELECT BACKFILL OR CONTROLLED LOW STRENGTH MATERIAL AS BACKFILL MATERIAL. BATCH ITEMS FOR CONTROLLED LOW STRENGTH MATERIAL MIX SHALL CONFORM TO M.A.S.S. SECTION 30.01, ARTICLE 1.3 MATERIALS. ENSURE AREA BELOW FOUNDATION MEETS COMPACTION REQUIREMENTS AND IS FREE OF LOOSE MATERIAL AND DEBRIS PRIOR TO CONCRETE WORK.
8. INSTALL ALL ANCHORS ACCORDING TO THE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS. ANCHORS SHALL BE INSTALLED PLUMB. ANCHORS GREATER THAN 1:40 OUT-OF-PLUMB WILL RESULT IN FOUNDATION REJECTION.
9. FOR THE BREAKAWAY LUMINAIRE POLE FOUNDATION, THE FRANGIBLE COUPLING REFERENCED IS NCHRP 350 COMPLIANT. THERE IS NO MASH COMPLIANT DEVICE AVAILABLE AT THIS TIME.
10. SPECIAL GRADING DETAIL AND/OR SHIELDING MAY BE REQUIRED TO MAINTAIN 4" MAXIMUM CLEAR DISTANCE.
11. CONTROLLED LOW STRENGTH MATERIAL MIX DESIGN SHALL FOLLOW APPLICABLE SPECIFICATION OF M.A.S.S. DIVISION 30.

REVISION: 2024 M.A.S.S. UPDATE

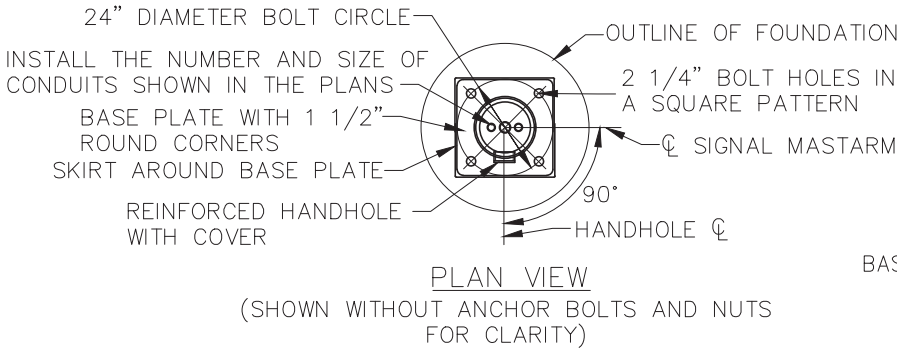
<p>MUNICIPALITY</p>  <p>OF ANCHORAGE</p>	<p>SCALE: N.T.S.</p> <p>APPROVED:</p> <p>REVISED: 2/24</p>	<p>CONCRETE FOUNDATION NOTES</p> <p>LUMINAIRE POLE</p>	<p>SECTION # 80.04</p> <p>DETAIL # 80-23</p>
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NOTE:
 ANGLE VARIES BASED ON MASTARM LENGTH:
 50° FOR 15' TO 35' MASTARMS
 45° FOR 40' TO 50' MASTARMS
 40° FOR 55' TO 65' MASTARMS



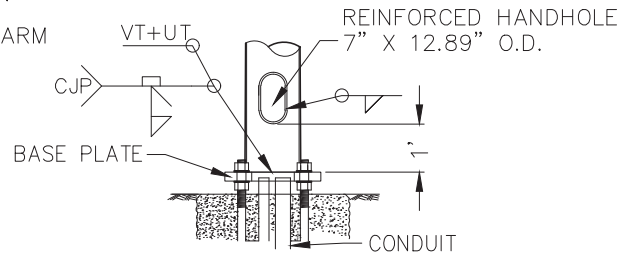
SIGNAL MASTARM CONNECTION DETAIL

NTS
 (ELEVATION VIEW OF A RING STIFFENED BUILT-UP BOX)

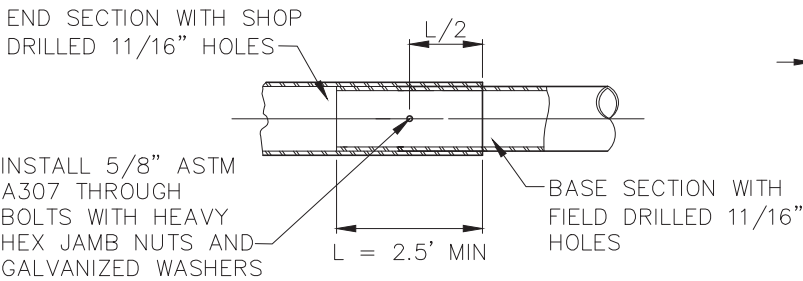


POLE BASE DETAIL

NTS

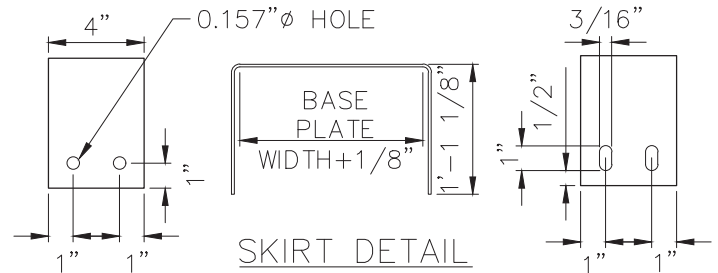


(SKIRT OMITTED FOR CLARITY)



MASTARM SLIP SPLICE ELEVATION DETAIL

NTS



NTS
 (TWO REQUIRED PER POLE)

NOTES FROM STANDARD DETAIL 80-25 APPLY TO ALL SIGNAL POLE INSTALLATIONS EXCEPT THAT NOTE 11 DOES NOT PERTAIN TO MASTARMS OF LESS THAN 40'.

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
 N.T.S.

APPROVED:

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 2/24

SIGNAL POLE DETAILS

SECTION #
 80.05

DETAIL #
 80-24

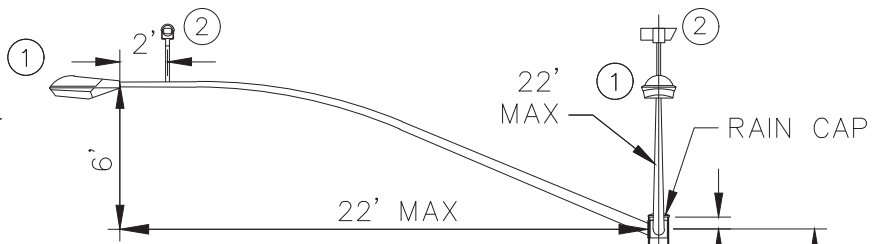
NOTES:

1. PROVIDE POLE ASSEMBLIES MEETING THE FOLLOWING DESIGN CRITERIA; 2001 AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS, THE LATEST EDITION OF THE MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS (M.A.S.S) AND, SPECIAL PROVISIONS. DESIGN FOR A BASIC WIND SPEED OF 100 MPH, FATIGUE CATEGORY III, WITH GALLOPING. MEASURE ALLOWED DEFLECTION DUE TO GALLOPING AT THE FREE END OF MASTARM.
2. PROVIDE POLES TO ACCOMMODATE THE MAXIMUM LENGTH SHOWN IN THE MASTARM DATA WITH THE GIVEN LOADS, DIMENSIONS AND MATERIAL REQUIREMENTS.
3. THIS DRAWING SHOWS LOADS (SIGNS AND SIGNALS) TO BE USED BY MANUFACTURERS WHEN DESIGNING POLES. IT DOES NOT SHOW ACTUAL LOADING OF POLES/MASTARMS ON INDIVIDUAL PROJECTS. THIS POLE/MASTARM DESIGN MAY BE USED WITHOUT FURTHER ANALYSIS IF THE FOLLOWING CONDITIONS ARE MET:
 - THE GUIDE SIGN (LOAD #7) IS ATTACHED TO THE MASTARM BASE SECTION AND,
 - NOT MORE THAN 4 TRAFFIC SIGNALS AND/OR SIGNS ARE ATTACHED TO THE END SECTION OF THE MASTARM.
 IF THESE CONDITIONS ARE NOT MET, THIS STANDARD POLE/MASTARM DESIGN MAY ONLY BE USED IF DESIGN COMPUTATIONS ARE SUBMITTED THAT DEMONSTRATE CONFORMANCE TO DESIGN CRITERIA USING ACTUAL LOADS. NOTE: DEVICES WITH LESS THAN 1 SQUARE FOOT OF PROJECTED AREA MAY BE ADDED TO THE MASTARM WITHOUT CAUSING A NEED FOR ADDITIONAL DESIGN COMPUTATIONS.
4. THE MANUFACTURER IS TO DETERMINE WELD SIZES. ALL WELDS AND TESTING SHALL CONFORM TO THE LATEST EDITION OF THE STRUCTURAL WELDING CODE AWS D1.1. PROVIDE VISUAL TEST (VT) OF 100% OF ALL WELDS. PROVIDE MAGNETIC PARTICLE TEST (MT) OF 100% OF ALL FILLET WELDS. PROVIDE RADIOGRAPHIC (RT) OR ULTRASONIC TEST (UT) OF 100% OF ALL COMPLETE JOINT PENETRATION WELDS AND A RANDOM 25% OF ALL PARTIAL JOINT PENETRATION LONGITUDINAL SEAM WELDS.
5. FABRICATE POLE TUBES FROM NO MORE THAN 2 PIECES OF STEEL. WHEN USING 2 PIECES, PLACE THE LONGITUDINAL WELDED SEAMS DIRECTLY OPPOSITE ONE ANOTHER.
6. FABRICATE LUMINAIRE ARMS AND CONNECTIONS ACCORDING TO STANDARD DETAIL 80-20.
7. PROVIDE PERMANENT TAGS ON ALL POLE SECTIONS IN ACCORDANCE WITH M.A.S.S. SECTION 80.05, ARTICLE 5.6. PROVIDE A RAIN CAP WHEN NO UPPER SECTION IS SPECIFIED.
8. THE TRAFFIC ENGINEER WILL REJECT DAMAGED OR DEFECTIVE POLES IN ACCORDANCE WITH M.A.S.S. SECTION 80.05 AND FOR ANY OF THE FOLLOWING; VARIANCES FROM APPROVED SHOP DRAWINGS, VARIANCES FROM MATERIAL REQUIREMENTS, SECTIONS MORE THAN 2-PERCENT OUT OF ROUND, SECTIONS BOWED MORE THAN 1-INCH THROUGHOUT THE LENGTH OF THE POLE, MASTARM, OR SEGMENT AND, DAMAGED OR DENTED FINISHES.
9. DRILL A 1" MAXIMUM DIAMETER HOLE AT EACH TRAFFIC SIGNAL LOCATION. ORIENT THE HOLE ON THE HORIZONTAL AXIS OF MASTARMS.
10. INSTALL POLE PLUMB BY ENSURING THE SIDE OPPOSITE THE MASTARM IS VERTICAL IN ITS FINAL DEFLECTED POSITION.
11. ALIGN WELDED SEAMS ON ADJACENT SECTIONS OF MASTARMS TO FORM CONTINUOUS STRAIGHT SEAMS THE LENGTH OF THE MASTARM. MECHANICALLY FORCE MASTARM SECTIONS TOGETHER FOR A SNUG FIT.
12. CLEAN AND REMOVE DIRT, BURRS, MILL SCALE, AND EXCESS GALVANIZATION ON ALL FAYING SURFACES AND THREADED PARTS BEFORE ASSEMBLY. LUBRICATE THE THREADS OF ALL BOLTS AND NUTS WITH LUBRICANT CONTAINING A VISIBLE DYE. TIGHTEN ALL BOLTS ACCORDING TO M.A.S.S SECTIONS 80.04 AND 80.05.

REVISION: 2024 M.A.S.S. UPDATE

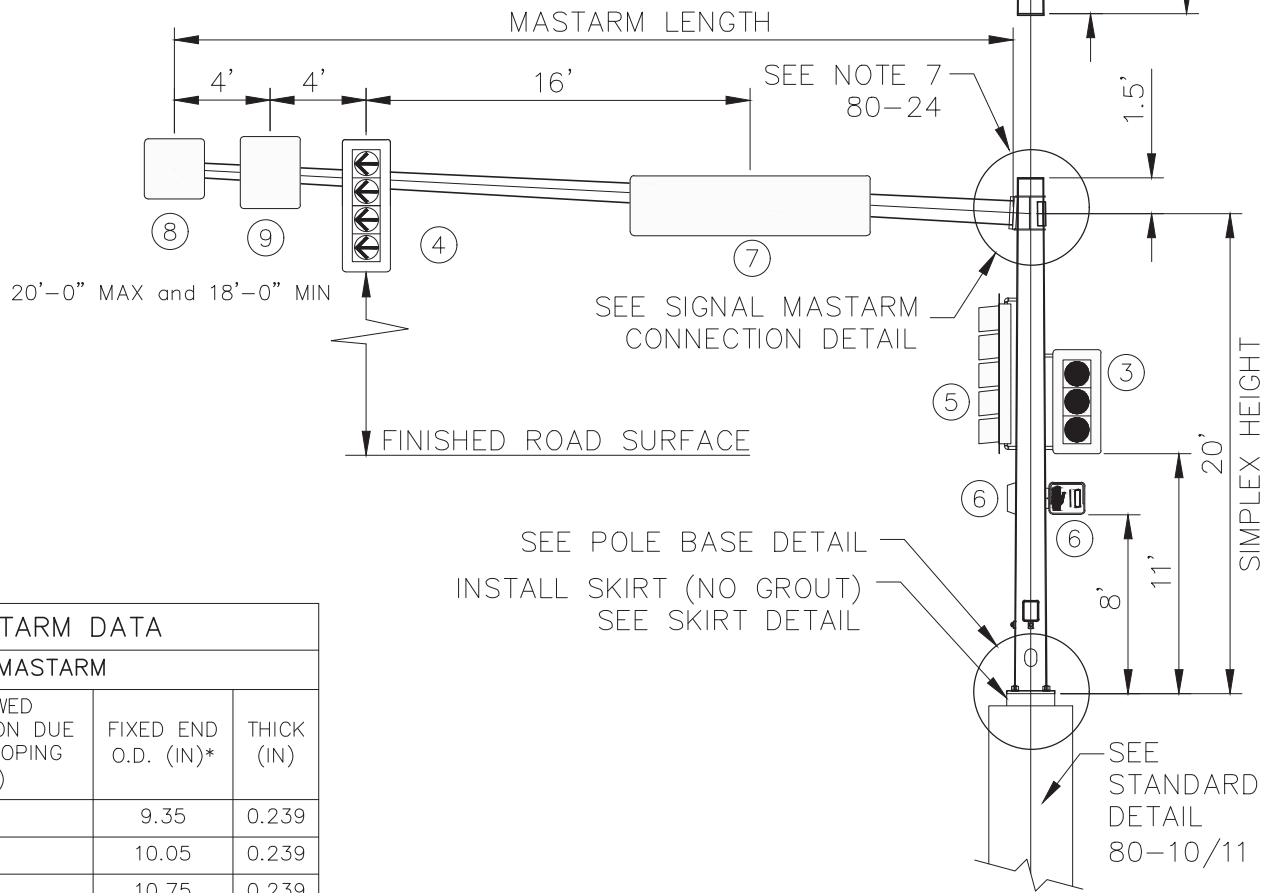
 <p>MUNICIPALITY OF ANCHORAGE</p>	<p>SCALE: N.T.S.</p> <p>APPROVED:</p> <p>REVISED: 2/24</p>	<h1>SIGNAL POLE NOTES</h1>	<p>SECTION # 80.05</p> <p>DETAIL # 80-25</p>
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ALL NOTES FROM STANDARD DETAIL 80-25 APPLY TO ALL SIGNAL POLE INSTALLATIONS EXCEPT THAT NOTE 11 DOES NOT PERTAIN TO MASTARMS OF LESS THAN 40'.



POLE DESIGN LOADING

LOAD COMPONENT	HEIGHT (FT)	WEIGHT (LBS)	ICE AREA (SQ FT)	WIND AREA (FACE-SQ FT)	WIND AREA (SIDE-SQ FT)
1 LUMINAIRE	0.67	50	6.00	2.00	2.00
2 CAMERA	0.50	20	2.00	0.5	1.00
3 SIGNAL	5.00	60	29.13	12.50	4.25
4 SIGNAL	5.33	100	46.26	20.44	4.25
5 SIGNAL	7.33	100	45.48	18.33	7.08
6 PED HEAD	1.33	25	6.83	2.00	0.67
7 SIGN	2.50	120	30.00	30.00	0.83
8 SIGN	2.50	25	6.25	6.25	0.83
9 SIGN	3.00	30	7.50	7.50	1.00



MASTARM DATA

MASTARM			
LENGTH (FT)	ALLOWED DEFLECTION DUE TO GALLOPING (IN)	FIXED END O.D. (IN)*	THICK (IN)
15	8	9.35	0.239
20	8	10.05	0.239
25	8	10.75	0.239
30	8	11.45	0.239
35	8	12.15	0.239

* FIXED END DIAMETER MEASURED AT CONNECTION TO BASEPLATE

REVISION: 2024 M.A.S.S. UPDATE



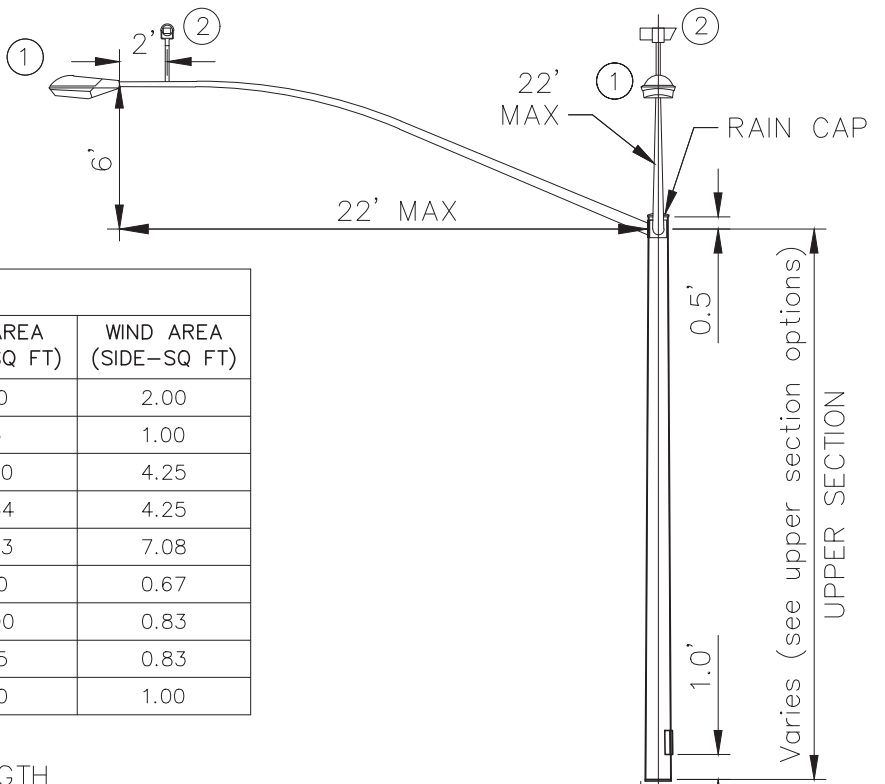
SCALE: N.T.S.
APPROVED:
REVISED: 2/24

SIGNAL POLE 15' TO 35' MASTARM ELEVATION VIEW

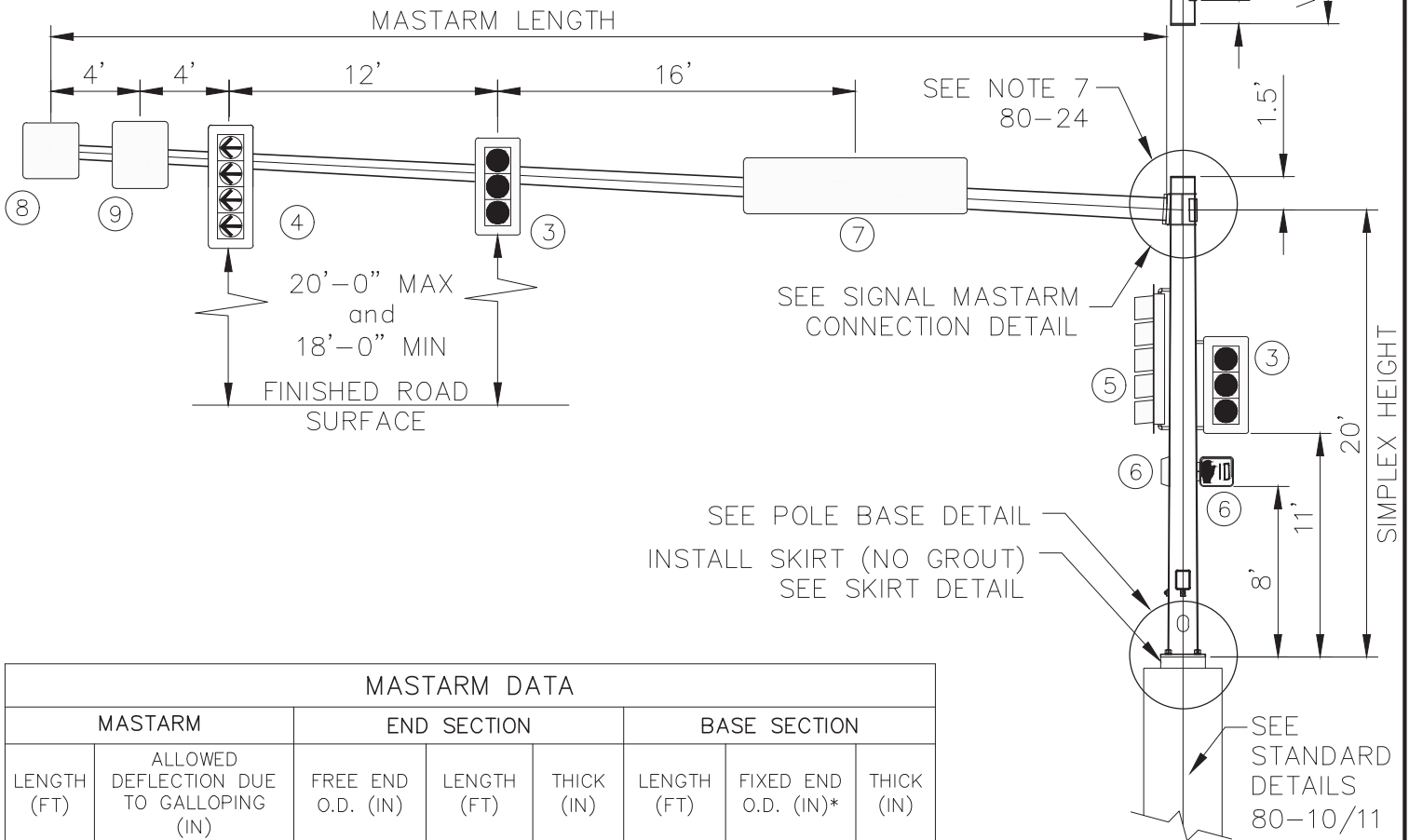
SECTION # 80.05

DETAIL # 80-26A

ALL NOTES FROM STANDARD DETAIL 80-25 APPLY TO ALL SIGNAL POLE INSTALLATIONS.



POLE DESIGN LOADING					
LOAD COMPONENT	HEIGHT (FT)	WEIGHT (LBS)	ICE AREA (SQ FT)	WIND AREA (FACE-SQ FT)	WIND AREA (SIDE-SQ FT)
1 LUMINAIRE	0.67	50	6.00	2.00	2.00
2 CAMERA	0.50	20	2.00	0.5	1.00
3 SIGNAL	5.00	60	29.13	12.50	4.25
4 SIGNAL	5.33	100	46.26	20.44	4.25
5 SIGNAL	7.33	100	45.48	18.33	7.08
6 PED HEAD	1.33	25	6.83	2.00	0.67
7 SIGN	2.50	120	30.00	30.00	0.83
8 SIGN	2.50	25	6.25	6.25	0.83
9 SIGN	3.00	30	7.50	7.50	1.00



MASTARM DATA							
MASTARM		END SECTION			BASE SECTION		
LENGTH (FT)	ALLOWED DEFLECTION DUE TO GALLOPING (IN)	FREE END O.D. (IN)	LENGTH (FT)	THICK (IN)	LENGTH (FT)	FIXED END O.D. (IN)*	THICK (IN)
40	8.0	7.3	25.0	0.1793	18.34	12.5	0.3125
45	8.0	7.3	25.0	0.1793	23.34	13.2	0.3125
50	8.0	7.3	25.0	0.1793	28.34	13.9	0.3125

* FIXED END DIAMETER MEASURED AT CONNECTION TO BASEPLATE

REVISION: 2024 M.A.S.S. UPDATE

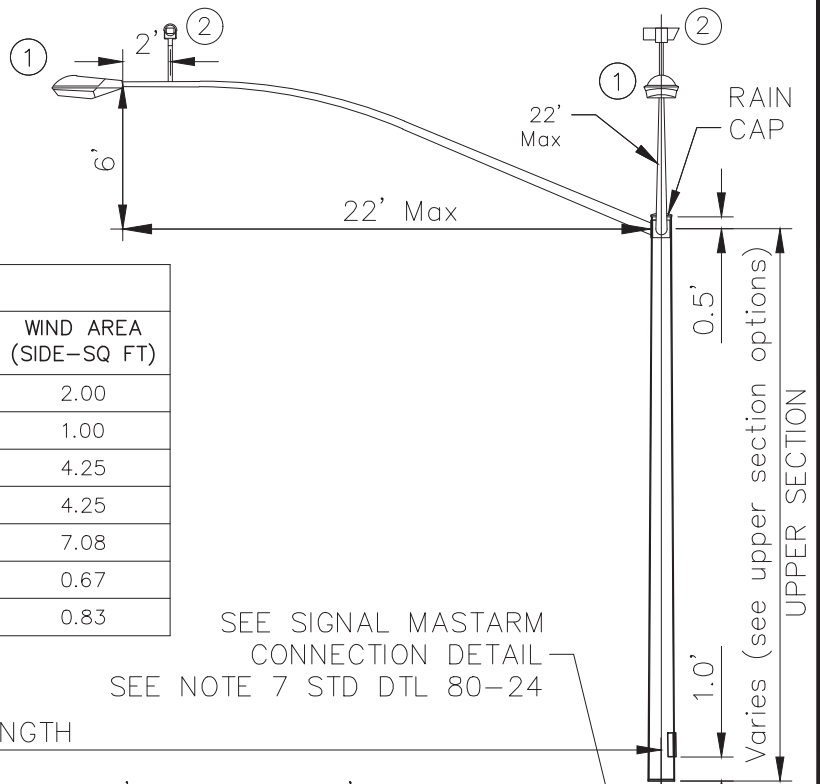


MUNICIPALITY OF ANCHORAGE
 SCALE: N.T.S.
 APPROVED:
 REVISED: 2/24

SIGNAL POLE 40' TO 50' MASTARM ELEVATION VIEW

SECTION # 80.05
 DETAIL # 80-26B

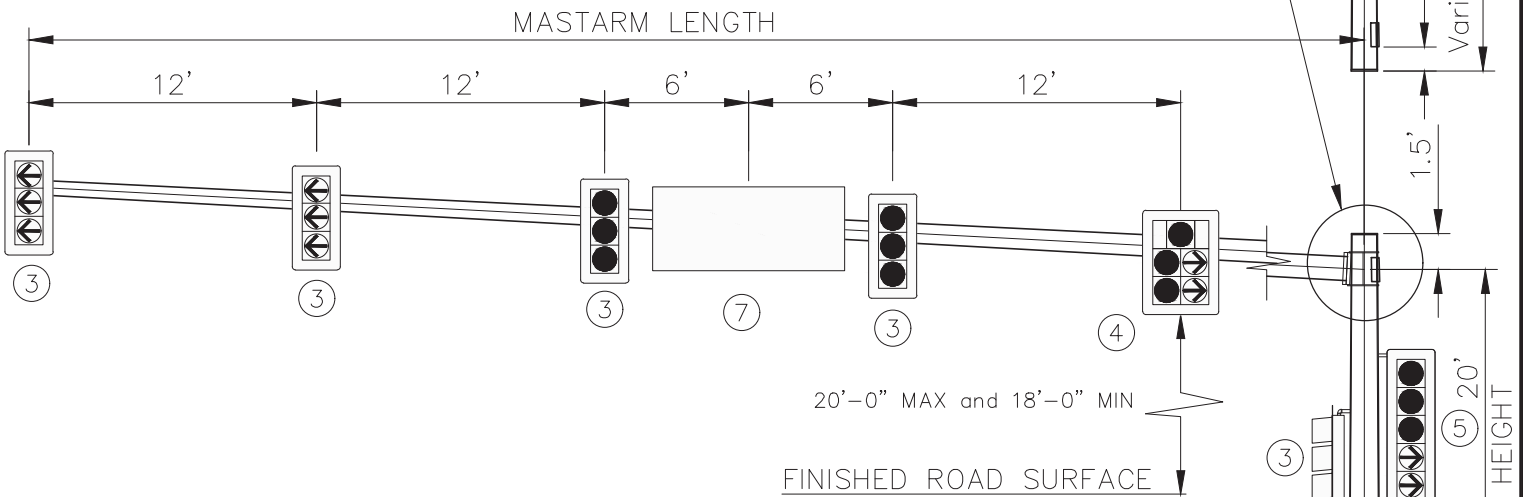
ALL NOTES FROM STANDARD DETAIL 80-25 APPLY TO ALL SIGNAL POLE INSTALLATIONS.



POLE DESIGN LOADING

LOAD COMPONENT	HEIGHT (FT)	WEIGHT (LBS)	ICE AREA (SQ FT)	WIND AREA (FACE-SQ FT)	WIND AREA (SIDE-SQ FT)
1 LUMINAIRE	0.67	50	6.00	2.00	2.00
2 CAMERA	0.50	20	2.00	0.5	1.00
3 SIGNAL	5.00	60	29.13	12.50	4.25
4 SIGNAL	5.33	100	46.26	20.44	4.25
5 SIGNAL	7.33	100	45.48	18.33	7.08
6 PED HEAD	1.33	25	6.83	2.00	0.67
7 SIGN	2.50	120	30.00	30.00	0.83

SEE SIGNAL MASTARM CONNECTION DETAIL
SEE NOTE 7 STD DTL 80-24



MASTARM DATA

MASTARM		END SECTION			BASE SECTION		
LENGTH (FT)	ALLOWED DEFLECTION DUE TO GALLOPING (IN)	FREE END O.D. (IN)	LENGTH (FT)	THICK (IN)	LENGTH (FT)	FIXED END O.D. (IN)*	THICK (IN)
55	10.0	7.3	25.0	0.1793	33.34	14.6	0.375
60	10.0	7.3	25.0	0.1793	38.34	15.3	0.375
65	10.0	7.3	25.0	0.1793	43.34	16.0	0.375

* FIXED END DIAMETER MEASURED AT CONNECTION TO BASEPLATE

SEE POLE BASE DETAIL
INSTALL SKIRT (NO GROUT) SEE SKIRT DETAIL
SEE STD DTLS 80-10/11

REVISION: 2024 M.A.S.S. UPDATE



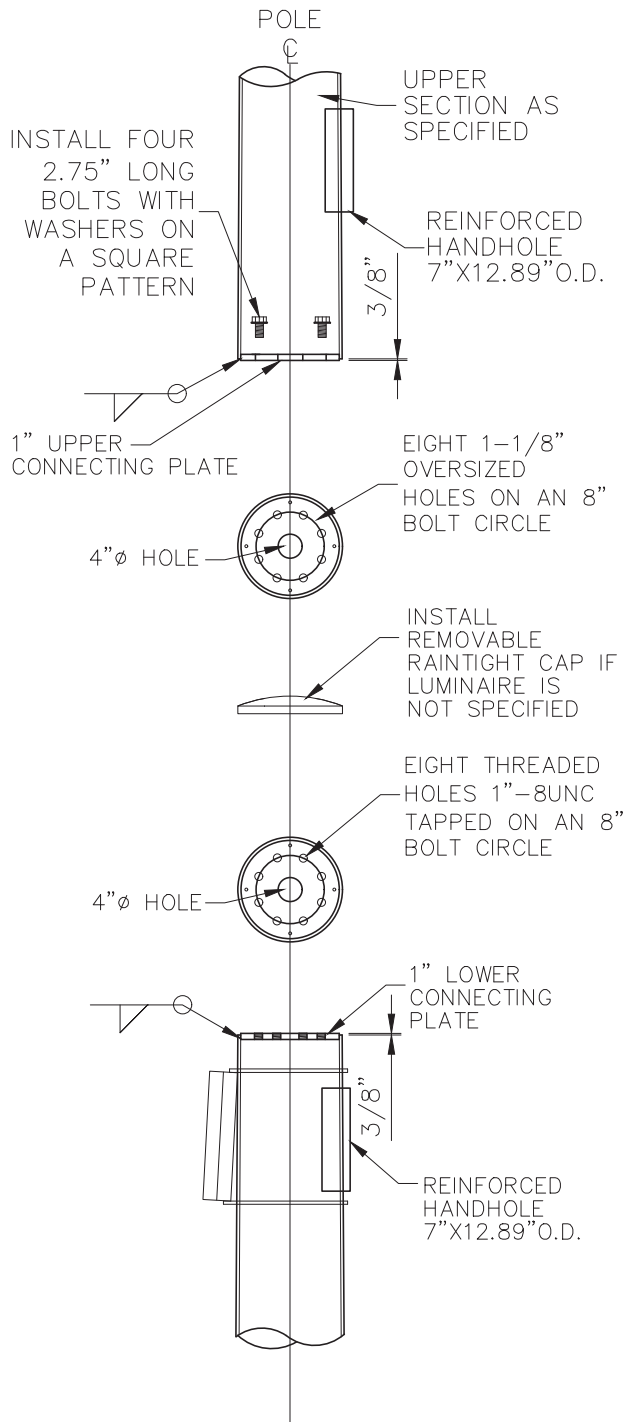
SCALE: N.T.S.
APPROVED:
REVISED: 2/24

SIGNAL POLE 55' TO 65' MASTARM ELEVATION VIEW

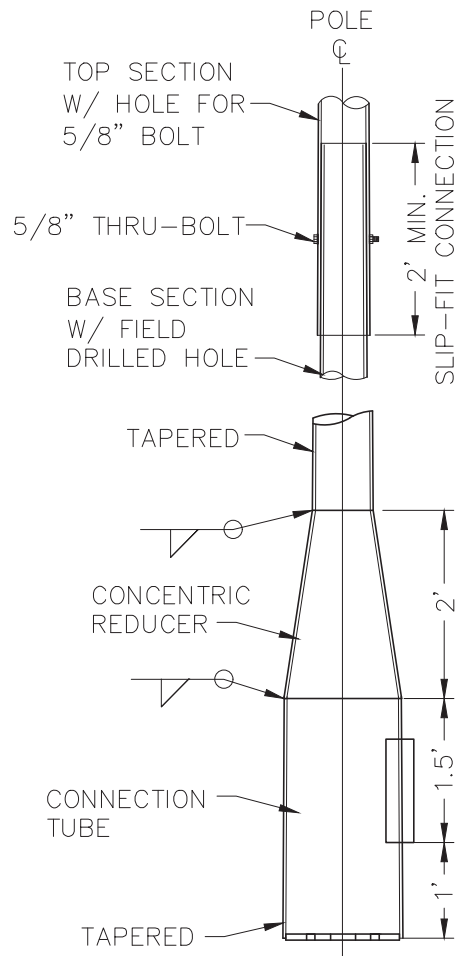
SECTION # 80.05

DETAIL # 80-26C

REVISION: 2024 M.A.S.S. UPDATE



POLE CONNECTION DETAIL



DAVIT CONNECTION DETAIL

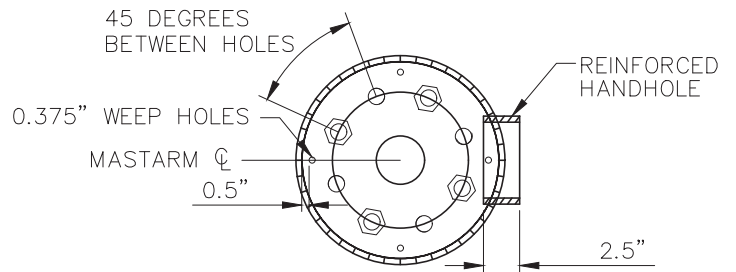


PLATE DETAILS

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

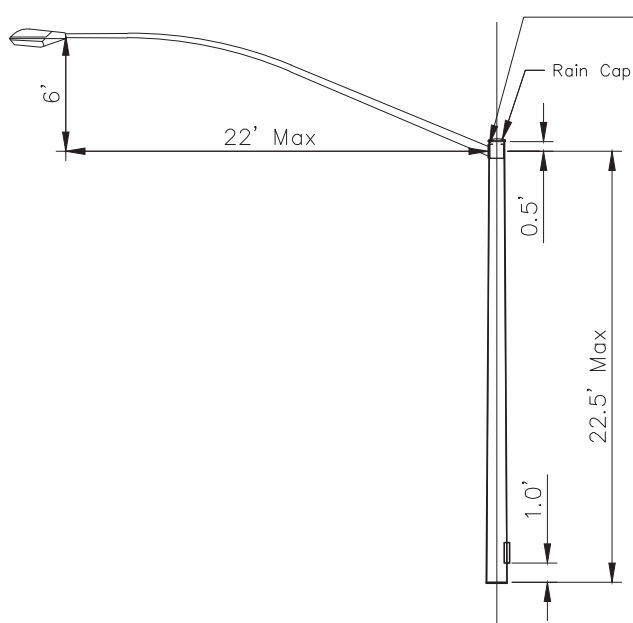
APPROVED:

REVISED:
2/24

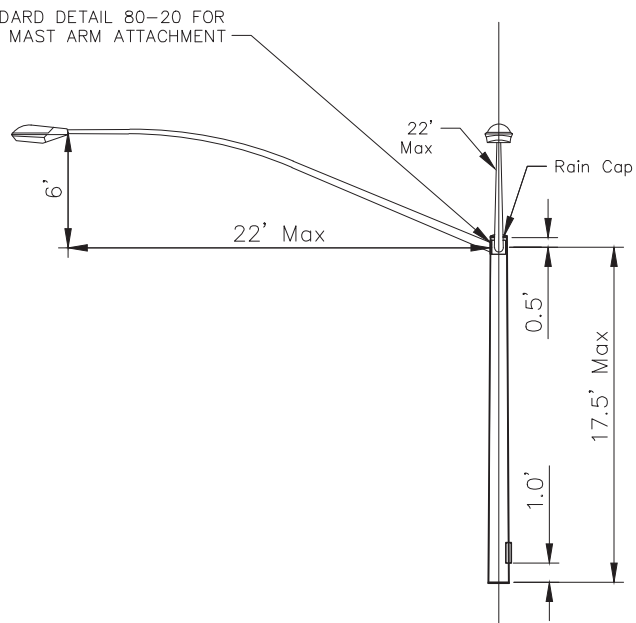
SIGNAL POLE UPPER SECTION OPTIONS PART 1

SECTION #
80.05

DETAIL #
80-26D

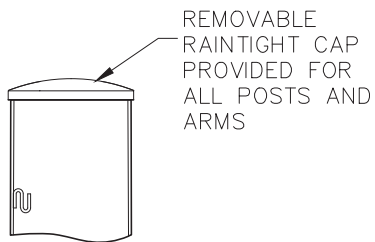


SINGLE LUMINAIRE

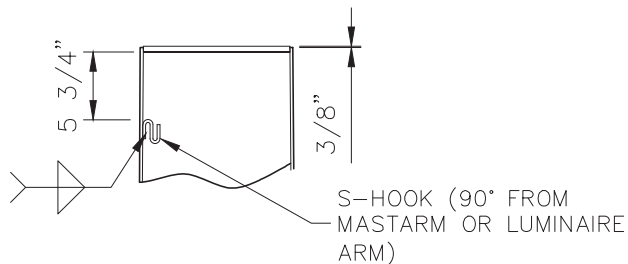


DOUBLE LUMINAIRE

UPPER SECTION OPTIONS
NTS



RAIN CAP DETAIL



LOWER SECTION POST TOP
NTS

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MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

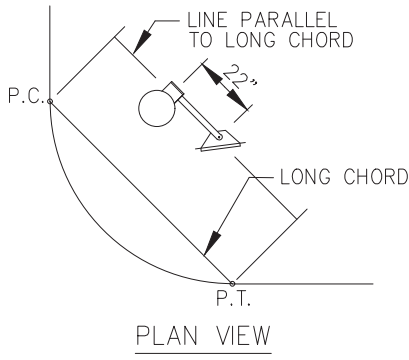
APPROVED:

REVISED:
2/24

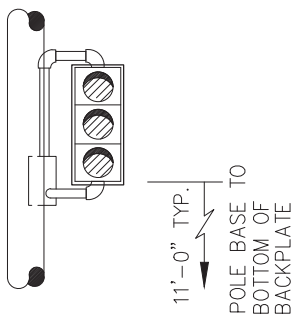
SIGNAL POLE
UPPER SECTION OPTIONS
PART 2

SECTION #
80.05

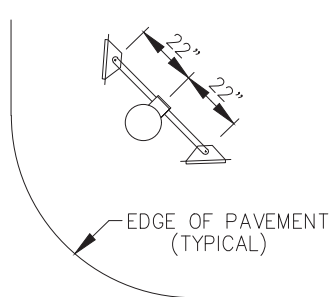
DETAIL #
80-26E



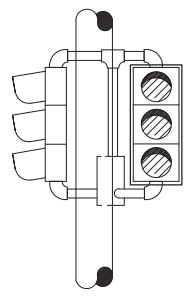
PLAN VIEW



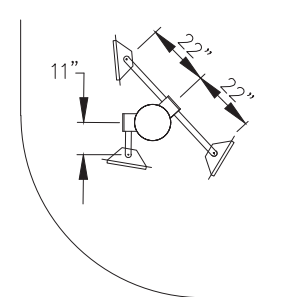
USE A ONE WAY, L.O.D. FRAME FOR INSTALLING ONE FACE



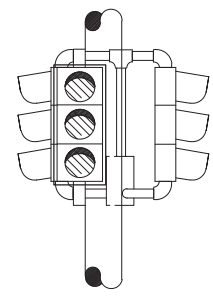
PLAN VIEW



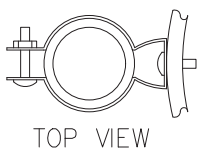
USE A TWO WAY FRAME FOR INSTALLING TWO FACES



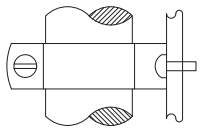
PLAN VIEW



USE TWO FRAMES FOR INSTALLING THREE FACES: A TWO WAY AND A ONE WAY R.O.D.



TOP VIEW

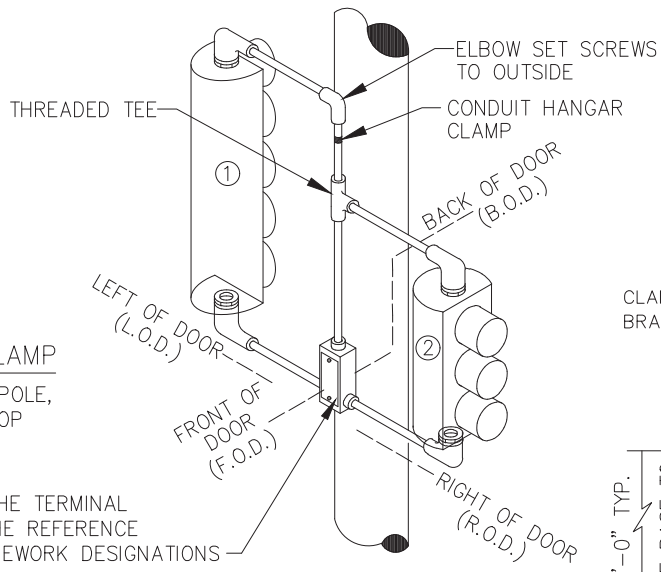


SIDE VIEW

CONDUIT HANGER CLAMP

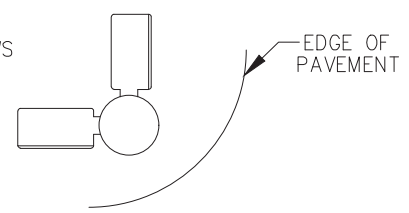
BOLTED TO THE SIGNAL POLE, 6" TO 12" BELOW THE TOP MOST 90° BEND

USE THE DOOR OF THE TERMINAL COMPARTMENT AS THE REFERENCE POINT FOR ALL FRAMEWORK DESIGNATIONS

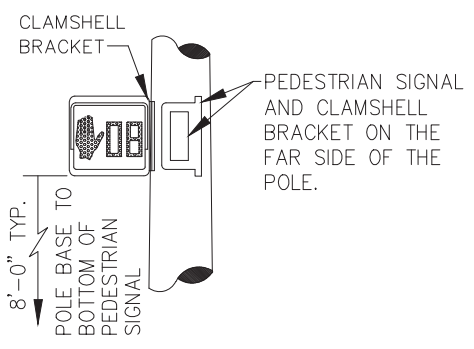


FRAMEWORK DESCRIPTION

HEAD NO. 1 OFFSET L.O.D.
HEAD NO. 2 OFFSET R.O.D.



PLAN VIEW



PEDESTRIAN SIGNAL

NOTE: SHOWN WITHOUT BACKPLATES

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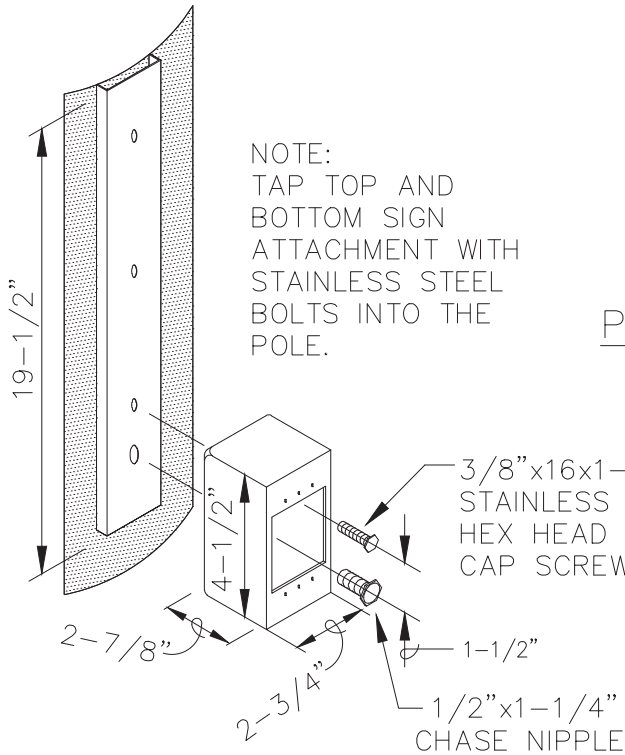
APPROVED:

REVISED:
2/24

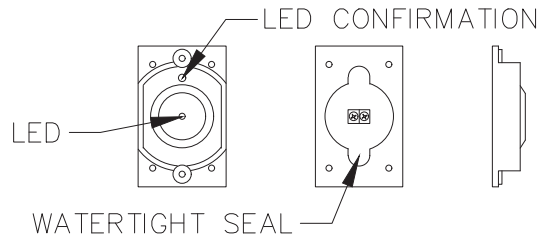
**SIDE-MOUNTED SIGNAL
DETAILS**

SECTION #
80.19

DETAIL #
80-27



NOTE:
TAP TOP AND
BOTTOM SIGN
ATTACHMENT WITH
STAINLESS STEEL
BOLTS INTO THE
POLE.

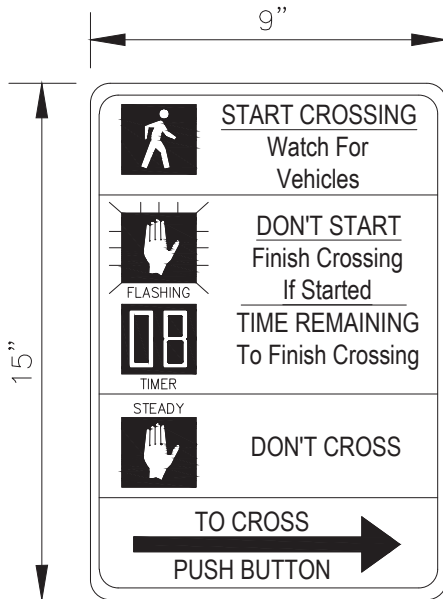


PEDESTRIAN PUSH BUTTON SWITCH

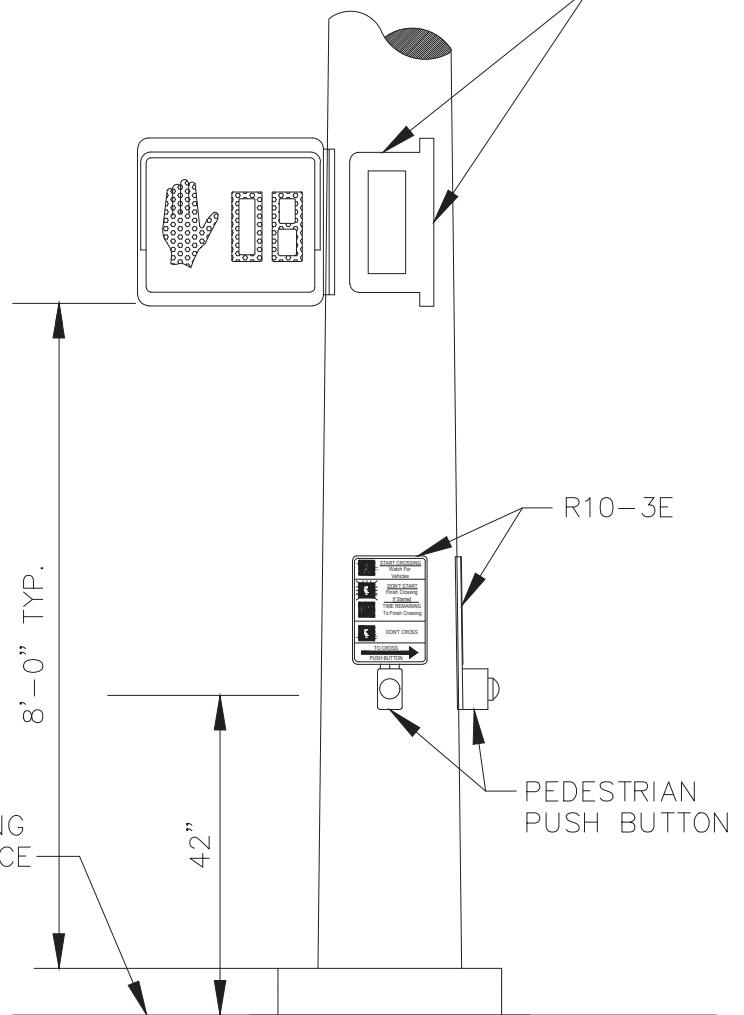
POLARA BULLDOG MODEL
RBDL3-B-4H, OR APPROVED EQUAL

PEDESTRIAN SIGNAL AND
CLAMSHELL BRACKET ON
THE FAR SIDE OF THE POLE

**PEDESTRIAN BUTTON
HOUSING DETAIL**



R10-3E
SIGN DETAIL



PEDESTRIAN HARDWARE

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OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

**PEDESTRIAN PUSH BUTTON
ASSEMBLY**

SECTION #
80.21

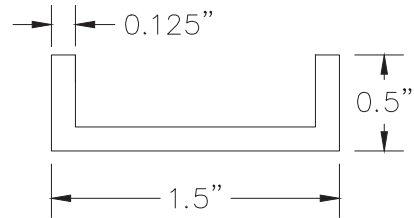
DETAIL #
80-28A

DRILL AND TAP MOUNTING HOLES IN POLE FOR 1/4" X 20 STAINLESS STEEL HEX CAP SCREWS AND STAINLESS STEEL FLAT WASHERS, SEE NOTE 2

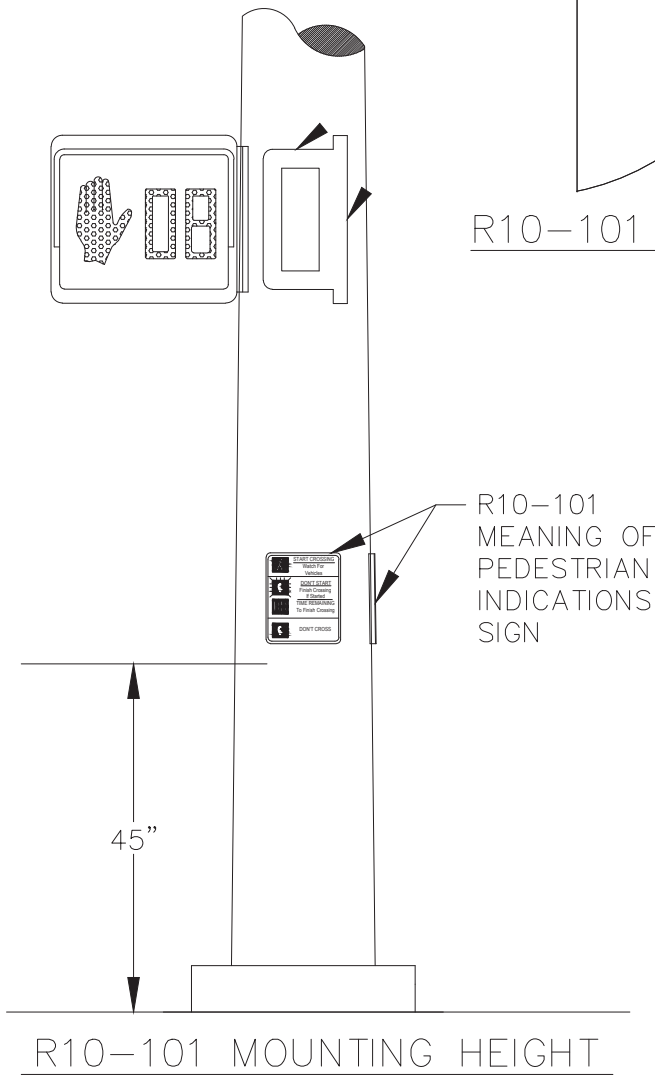
DRILL SLIGHTLY OVERSIZED HOLES IN ALUMINUM CHANNEL

11.5"

R10-101 SIGN MOUNT



ALUMINUM ARCHITECTURAL CHANNEL 6063-T52



R10-101 MEANING OF PEDESTRIAN INDICATIONS SIGN

R10-101 MOUNTING HEIGHT

NOTES:

1. INSTALL THE R10-101 MEANING OF PEDESTRIAN INDICATIONS SIGNS SHOWN IN THE PLANS AS DETAILED ON THIS SHEET AND PER ALASKA TRAFFIC MANUAL.
2. POSITION MOUNTING HOLES SO THAT CAP SCREW AND FLAT WASHERS DON'T OBSCURE SIGN LEGEND.

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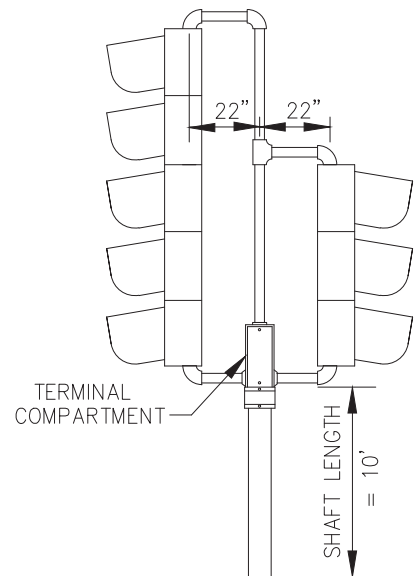
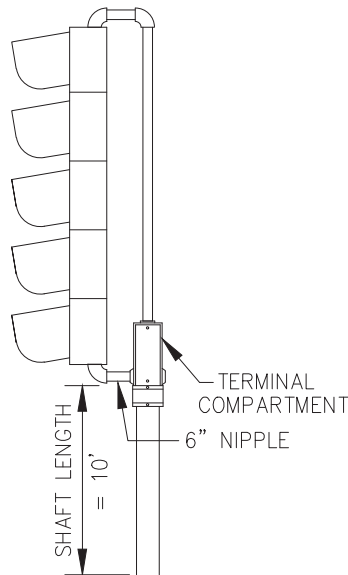
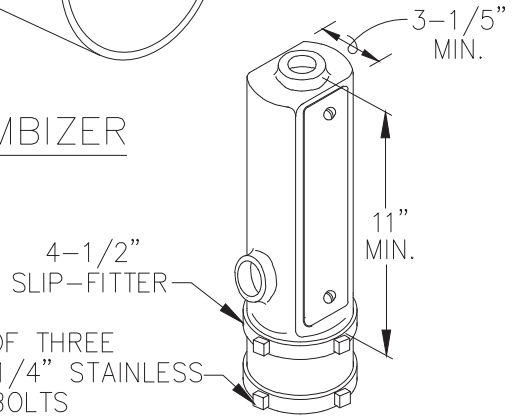
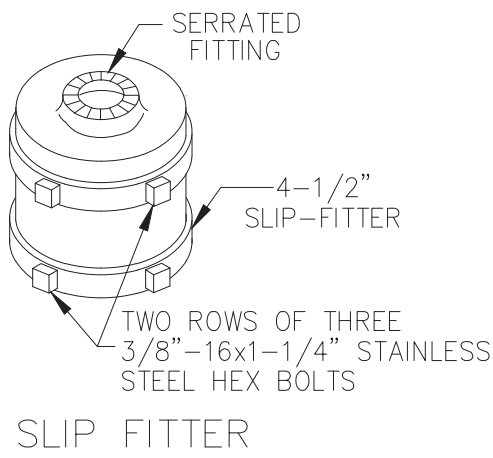
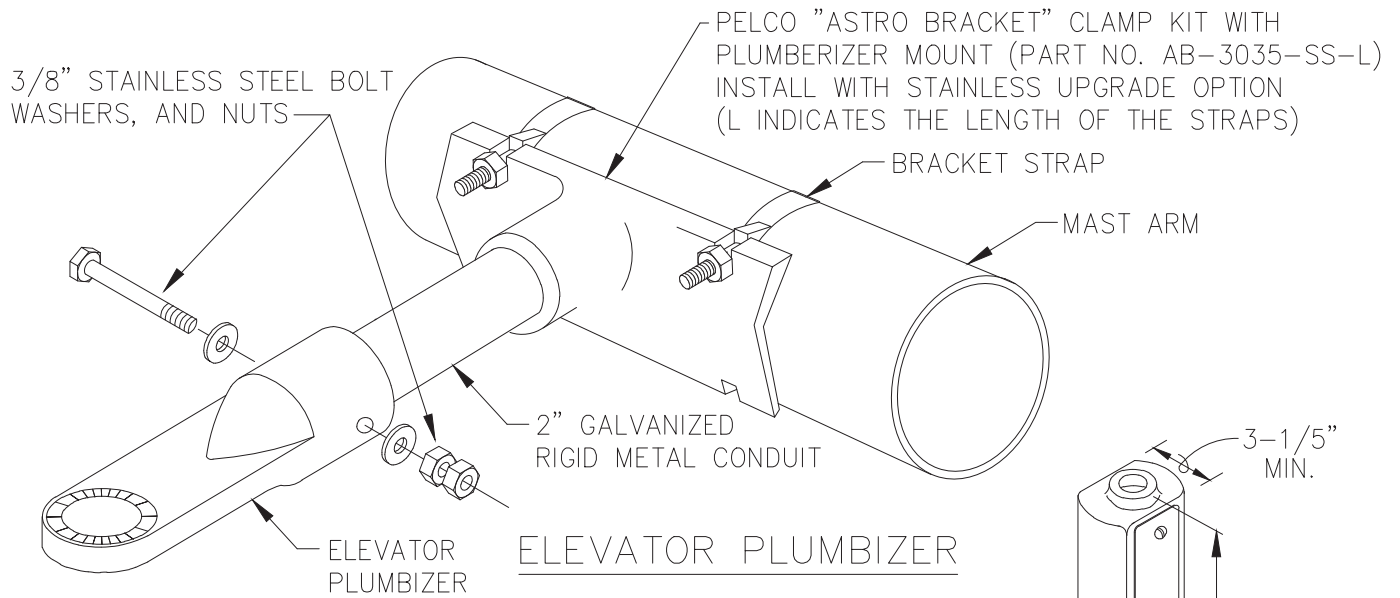


SCALE: N.T.S.
 APPROVED:
 REVISED: 2/24

R10-101 PEDESTRIAN SIGN MOUNTING DETAILS

SECTION # 80.21

DETAIL # 80-28B



POST TOP MOUNTED SIGNAL DETAILS
(SHOWN WITHOUT BACKPLATES)

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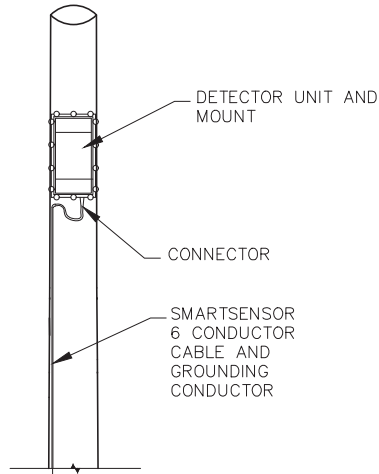
REVISED:
2/24

POST TOP AND MAST ARM MOUNTED SIGNAL DETAILS

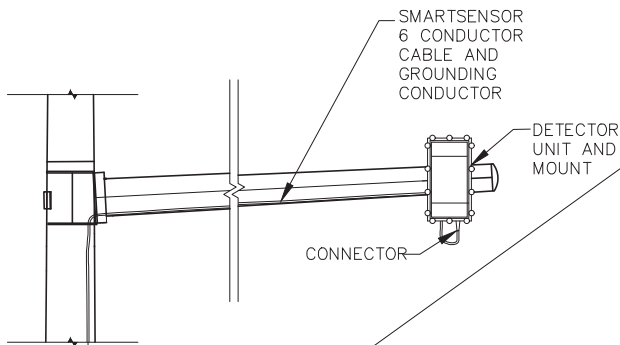
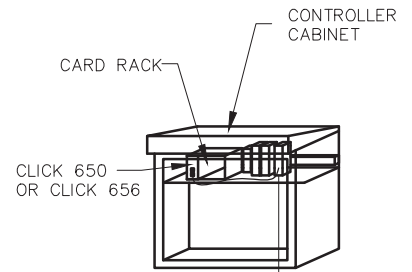
SECTION #
80.19

DETAIL #
80-29A

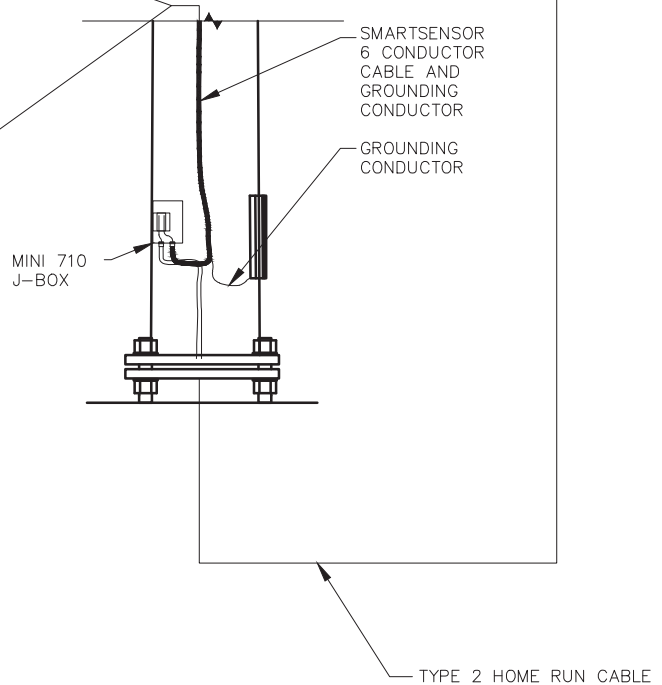
NOTES:
 NOTES AND EQUIPMENT LISTS
 ARE PROVIDED ON
 STANDARD DETAIL 80-29C.



SIDE POLE
 MOUNTING STYLE 1



MASTARM
 MOUNTING STYLE 2



REVISION: 2024 M.A.S.S. UPDATE



SCALE:
 N.T.S.

APPROVED:

REVISED:
 2/24

RADAR DETECTION DETAILS

SECTION #
 80.19

DETAIL #
 80-29B


NOTES:

1. PROTECT CABLE ENDS FROM MOISTURE AT ALL TIMES.
2. PULL CABLE IN ACCORDANCE WITH MASS DIVISION 80. PULL CABLE SO THAT THERE IS SUFFICIENT LENGTH TO REACH THE TOP OF THE CONTROLLER CABINET. WHEN CABLE HAS BEEN PULLED TO FINAL LOCATIONS INSTALL AND MAKE FINAL CONNECTIONS.
3. CABLE RUNS ARE TO BE MADE CONTINUOUS WITHOUT SPLICES.
4. CABLE WITH DAMAGED INSULATION, OR THAT HAS BEEN CRIMPED OR BENT BEYOND THE MINIMUM BEND RADIUS MUST BE REPLACED AT CONTRACTORS EXPENSE.
5. THE MINIMUM BEND RADIUS SHALL NOT EXCEED MANUFACTURERS RECOMMENDATIONS.
6. ENSURE ADEQUATE LENGTH OF EACH CABLE TO ALLOW WORK ON THE ENDS OF THE CABLE IN THE CONTROLLER CABINET, AT THE POLE MOUNT ENCLOSURE AND RADAR MOUNTING LOCATION.
7. MOUNT THE RADAR AT THE LOCATION STATED IN THE PLANS. PLACEMENT MAY BE ADJUSTED BY THE ENGINEER TO ALLOW FOR BETTER AIMING OF THE RADAR OR TO AVOID OTHER HAZARDS.
8. INSTALL WATERTIGHT THREADED RIGID COMPRESSION CONNECTOR WHERE CABLE PASSES THROUGH THE POLE.
9. FURNISH ONLY NEW EQUIPMENT OF THE BRAND AND TYPE LISTED OR ITS APPROVED EQUAL. PROVIDE AT NO ADDITIONAL COST ALL NECESSARY DEVICES, WIRES, BRACKETS/HARDWARE ETC. TO PROVIDE A FULLY FUNCTIONING RADAR DETECTION SYSTEM.
10. INSTALL #10 AWG GROUNDING CONDUCTOR WITH GREEN COLORED INSULATION BETWEEN THE EXTERNAL GROUNDING LUG ON THE SMARTSENSOR UNIT AND THE HAND HOLE AT THE POLE BASE. CONNECT THE GROUNDING CONDUCTOR TO A POLE GROUNDING CONDUCTOR USING AN IRREVERSIBLE COMPRESSION CONNECTOR. IDENTIFY THE CONDUCTOR WITH TAG AS "RADAR GND".

MATRIX RADAR DETECTION EQUIPMENT
ITEMS TO BE PROVIDED FOR INSTALLATION
SENSOR MOUNT – 6" 3 AXIS ALUM. BRACKET. (SS-611)
MINI 710- SENSOR CABLE J-BOX WITH TERMINAL BLOCKS (102-0453)
MATRIX TYPE 2 HOME RUN CABLE (MTX2 HMRN)
SMARTSENSOR 6 CONDUCTOR CABLE (SS-704-040) WITH SINGLE END CONNECTOR (SS-709) FACTORY INSTALLED
SMARTSENSOR MATRIX (SS-225)
KNUCKLE BRACKET (360-0129), WHEN IDENTIFIED IN PLANS

ADVANCE RADAR DETECTION EQUIPMENT
ITEMS TO BE PROVIDED FOR INSTALLATION
SENSOR MOUNT – 6" 3 AXIS ALUM. BRACKET. (SS-611)
MINI 710- SENSOR CABLE J-BOX WITH TERMINAL BLOCKS (102-0453)
MATRIX TYPE 2 HOME RUN CABLE (MTX2 HMRN)
SMARTSENSOR 6 CONDUCTOR CABLE (SS-704-XXX) WITH SINGLE END CONNECTOR (SS-709) FACTORY INSTALLED
SMARTSENSOR ADVANCE EXTENDED RANGE (SS-200E)
SMARTSENSOR ADVANCE VIEW FINDER (360-0283)
KNUCKLE BRACKET (360-0129), WHEN IDENTIFIED IN PLANS

REVISION: 2024 M.A.S.S. UPDATE

 MUNICIPALITY OF ANCHORAGE	SCALE: N.T.S. APPROVED: REVISED: 2/24	<h2 style="margin: 0;">RADAR DETECTION NOTES AND EQUIPMENT LISTS</h2>	SECTION # 80.19 DETAIL # 80-29C
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SEE MASS DETAIL 80-29E
FOR NOTES AND
ADDITIONAL DETAILS

CAMERA LOCATION

SEE CAMERA/HOUSING
DETAIL

SEE NOTE 9

VARIABLES (SEE PLANS)

VARIABLES (SEE PLANS)
UPPER SECTION

20'
SIMPLEX HEIGHT

SIGNAL
POLE

POLE MOUNT
BRACKET

CABLE 1, ROUTE THROUGH POLE
MOUNT BRACKET AND WALL
MOUNT ADAPTER.

ADAPTER
HARDWARE

WALL &
POLE MOUNT

WALL MOUNT
ADAPTER

AXIS CABLE

AXIS CONNECTOR

INTERNAL THERMOST
CONTROLLED HEATER
AND FAN

PAN, TILT, ZOOM (PTZ)
CAMERA

CAMERA/HOUSING
DETAIL
NTS

CONTROLLER
CABINET

SWITCH/ROUTER

CABLE 1

CONNECTOR

CONDUIT FROM CABINET

SYSTEM LAYOUT
NTS

REVISION: 2024 M.A.S.S. UPDATE

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SCALE:
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APPROVED:

REVISED:
2/24

PAN, TILT, ZOOM, CAMERA MOUNTING DETAILS

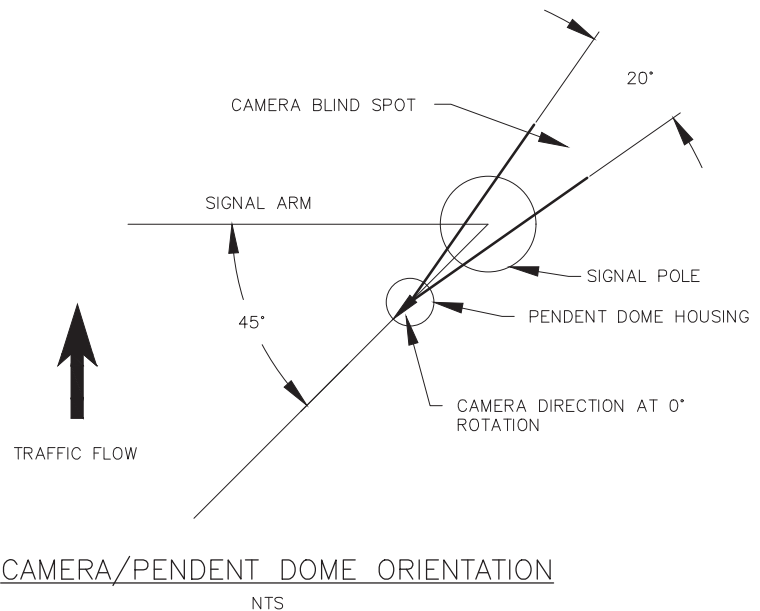
SECTION #
80.19

DETAIL #
80-29D

MATERIAL REQUIREMENTS	
ALL ASSEMBLIES	
MOUNTING BRACKET	ASTRO-BRAC AB-0160-45-SS-PNC
WALL ADAPTOR	STEEL FABRICATORS OR APPROVED EQUAL
WALL MOUNT	AXIS T91L61 OR APPROVED EQUAL
CABLE 1 (SIGNAL)	CAT-5E, SHIELDED, DIRECT BURIAL
CONNECTOR	ENVIRONMENTALLY HARDENED RJ-45
STRAIN RELIEF	REMKE 2201-013 OR APPROVED EQUAL
	CAMERA
CAMERA	SEE SPECIFICATIONS

NOTES:

1. PROTECT CABLE ENDS FROM MOISTURE AT ALL TIMES.
2. PULL CABLE IN ACCORDANCE WITH MASS DIVISION 80. PULL CABLE SO THAT THERE IS SUFFICIENT LENGTH TO REACH THE TOP OF THE CONTROLLER CABINET. CABLES ARE TO BE PULLED WITHOUT CONNECTORS ATTACHED. WHEN CABLE HAS BEEN PULLED TO FINAL LOCATIONS INSTALL AND MAKE FINAL CONNECTIONS.
3. CABLE RUNS ARE TO BE MADE CONTINUOUS WITHOUT SPLICES.
4. CABLE WITH DAMAGED INSULATION, OR THAT HAS BEEN CRIMPED OR BENT BEYOND THE MINIMUM BEND RADIUS MUST BE REPLACED AT NO ADDITIONAL COST.
5. THE MINIMUM BEND RADIUS SHALL NOT EXCEED THE MANUFACTURERS RECOMMENDATIONS.
6. ENSURE ADEQUATE LENGTH OF EACH CABLE TO ALLOW WORK ON THE ENDS OF THE CABLE IN THE CONTROLLER CABINET AND THE CAMERA MOUNTING LOCATION.
7. MOUNT THE PENDENT DOME HOUSING AT A 45° ANGLE AT THE REQUIRED HEIGHT. ANGLE AND HEIGHT MAY BE ADJUSTED BY THE ENGINEER TO AVOID WELDS, APPENDICES AND TO APPROVE SIGHT DISTANCE.
8. ADJUST CAMERA INSIDE THE PENDENT DOME HOUSING AS SHOWN. ENSURE THAT THE CAMERA IS MOUNTED AT A 0° TILT ANGLE.
9. CAMERA/HOUSING MOUNTING HEIGHT TO BE DETERMINED IN THE FIELD BY THE ENGINEER.



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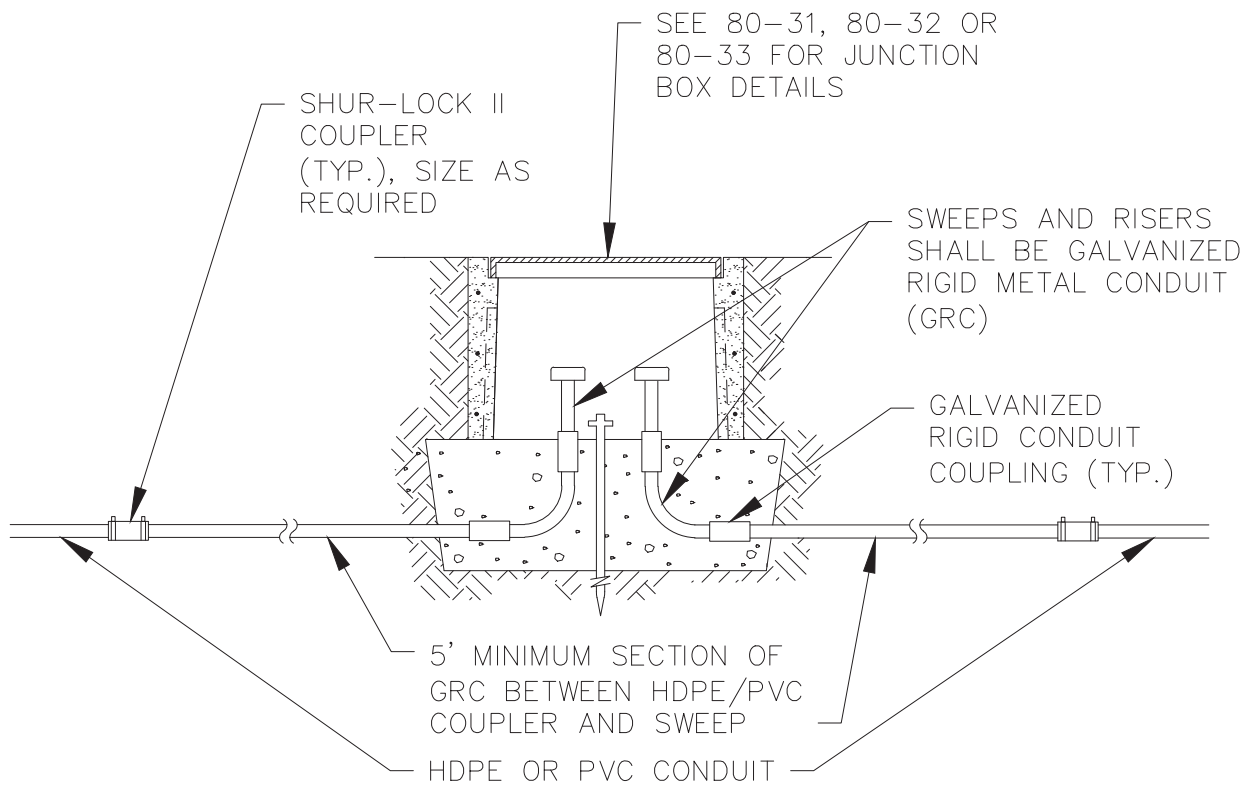
MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

**PAN, TILT, ZOOM, CAMERA
 NOTES AND MATERIAL
 REQUIREMENTS**

SECTION #
80.19
 DETAIL #
80-29E



SIZE CONDUIT AS SHOWN ON DRAWINGS

REVISION: 2024 M.A.S.S. UPDATE



SCALE:
N.T.S.

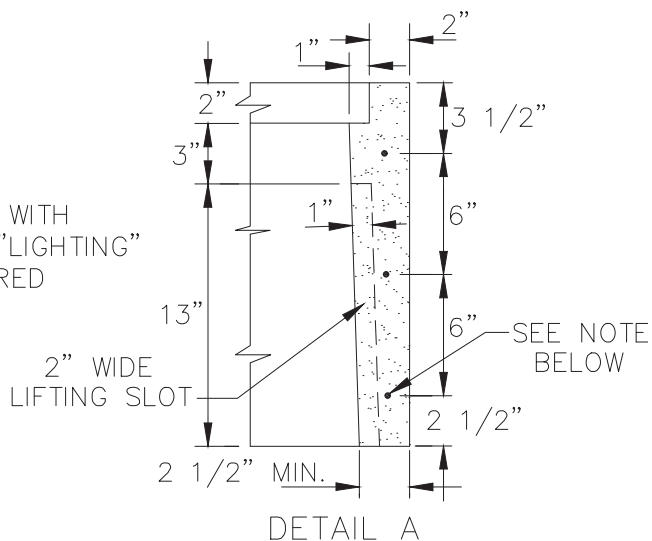
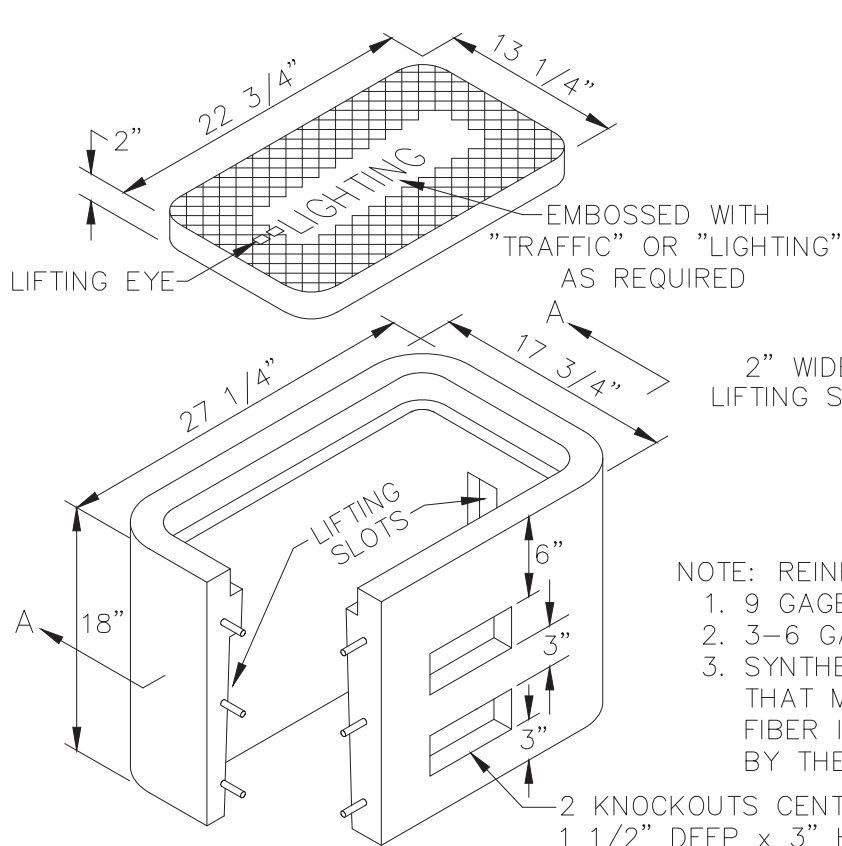
APPROVED:

REVISED:
2/24

HDPE/PVC TRANSITION DETAIL

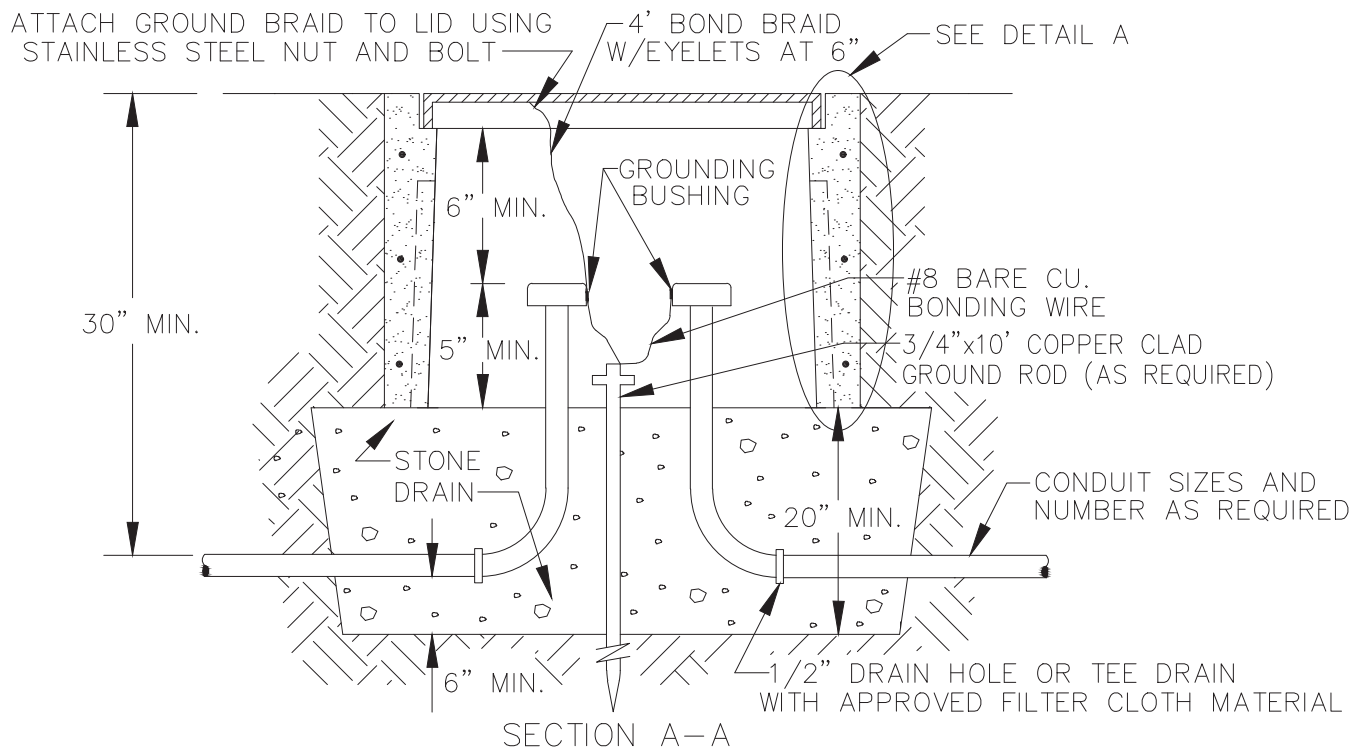
SECTION #
80.07

DETAIL #
80-30



NOTE: REINFORCEMENT MAY CONSIST OF;

1. 9 GAGE WELDED WIRE FRAME.
2. 3-6 GAGE HORIZONTAL WIRE LOOPS.
3. SYNTHETIC FIBER REINFORCED CONCRETE THAT MEETS ASTM C 1116 AND CONTAINS FIBER IN PROPORTIONS AS RECOMMENDED BY THE FIBER MANUFACTURER.



REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

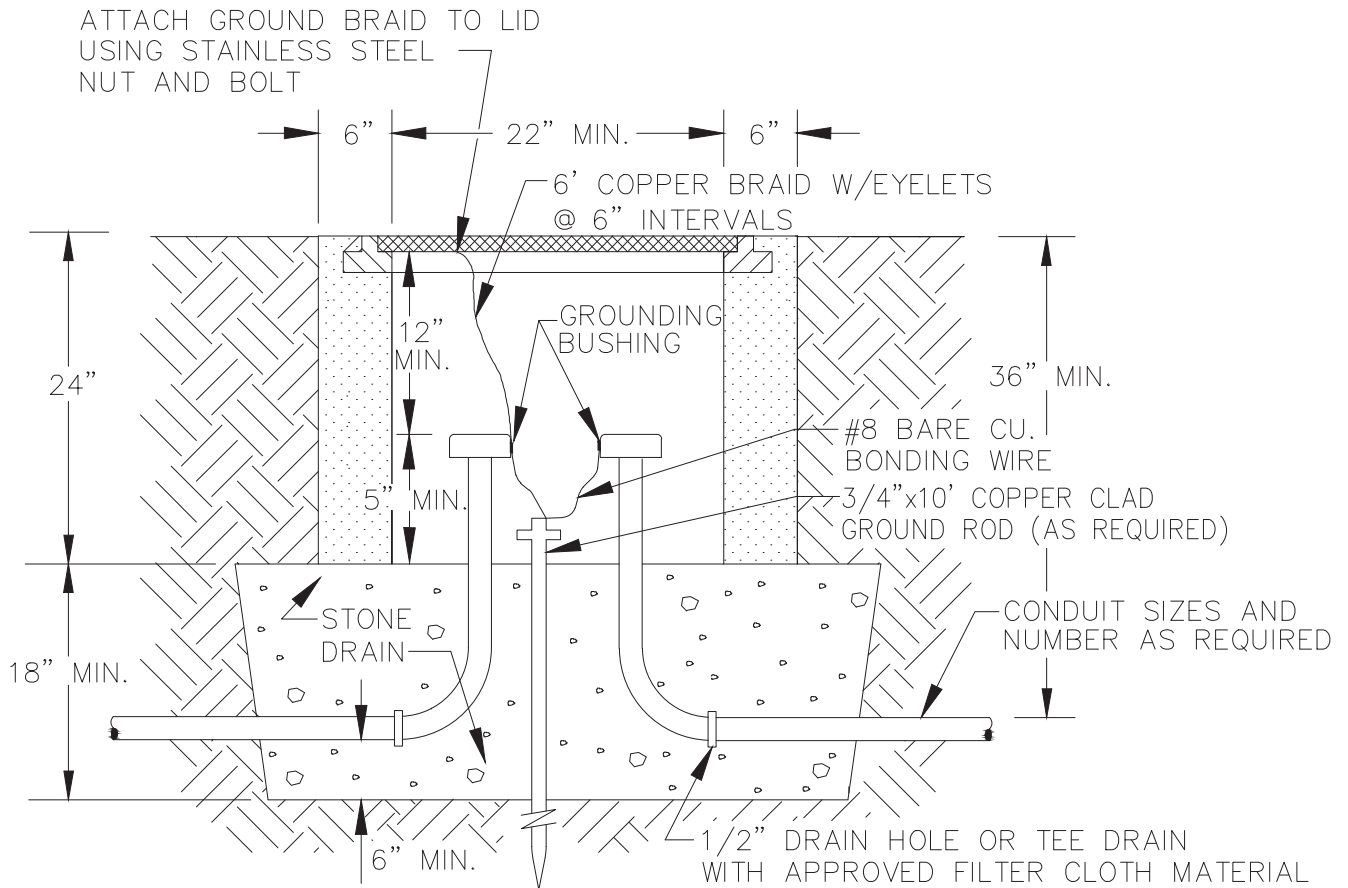
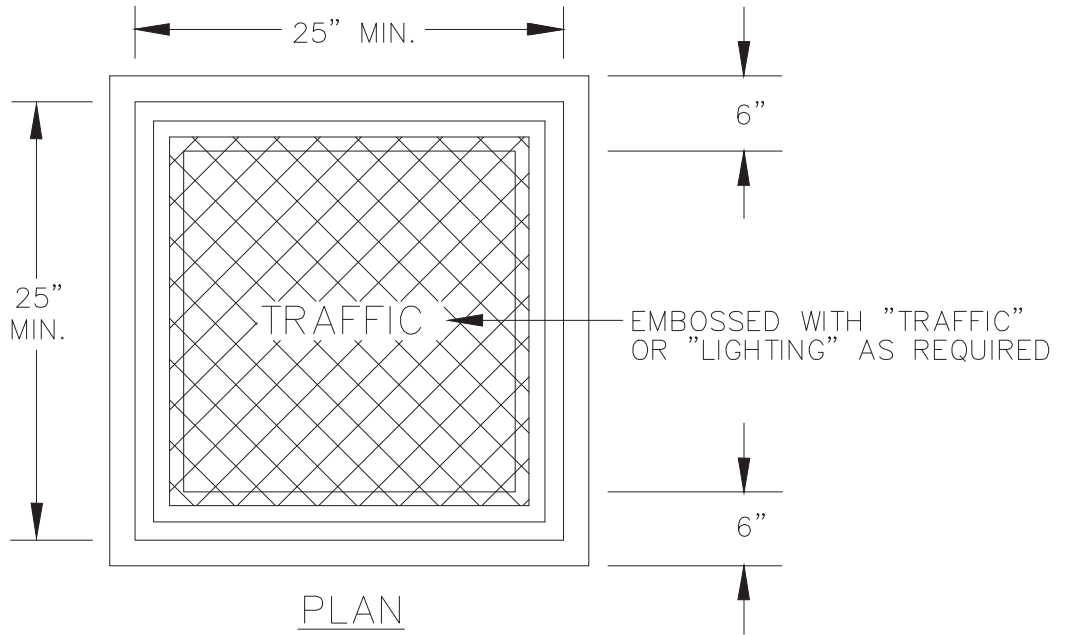
REVISED:
2/24

TYPE 1A JUNCTION BOX

SECTION #
80.08

DETAIL #
80-31

NOTE: WHEN A MODIFIED TYPE II JUNCTION BOX IS INDICATED IN THE DRAWINGS ADD ONE ADDITIONAL 5" DEEP x 3" HIGH x 18" WIDE KNOCKOUT 12" BELOW TOP OF JUNCTION BOX



SECTION

REVISION: 2024 M.A.S.S. UPDATE

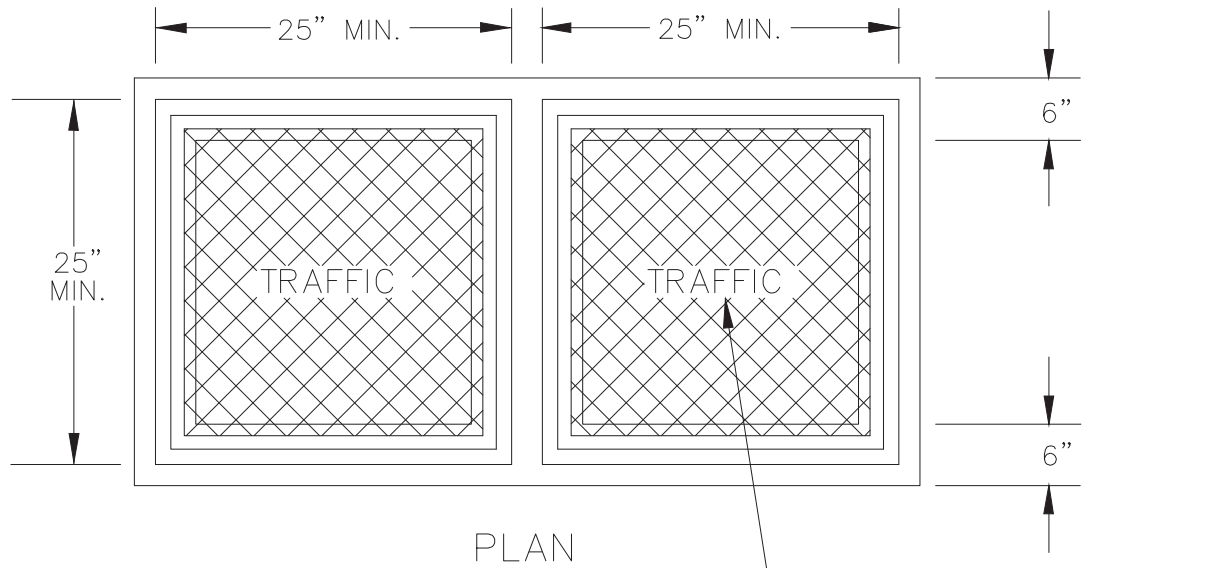
MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

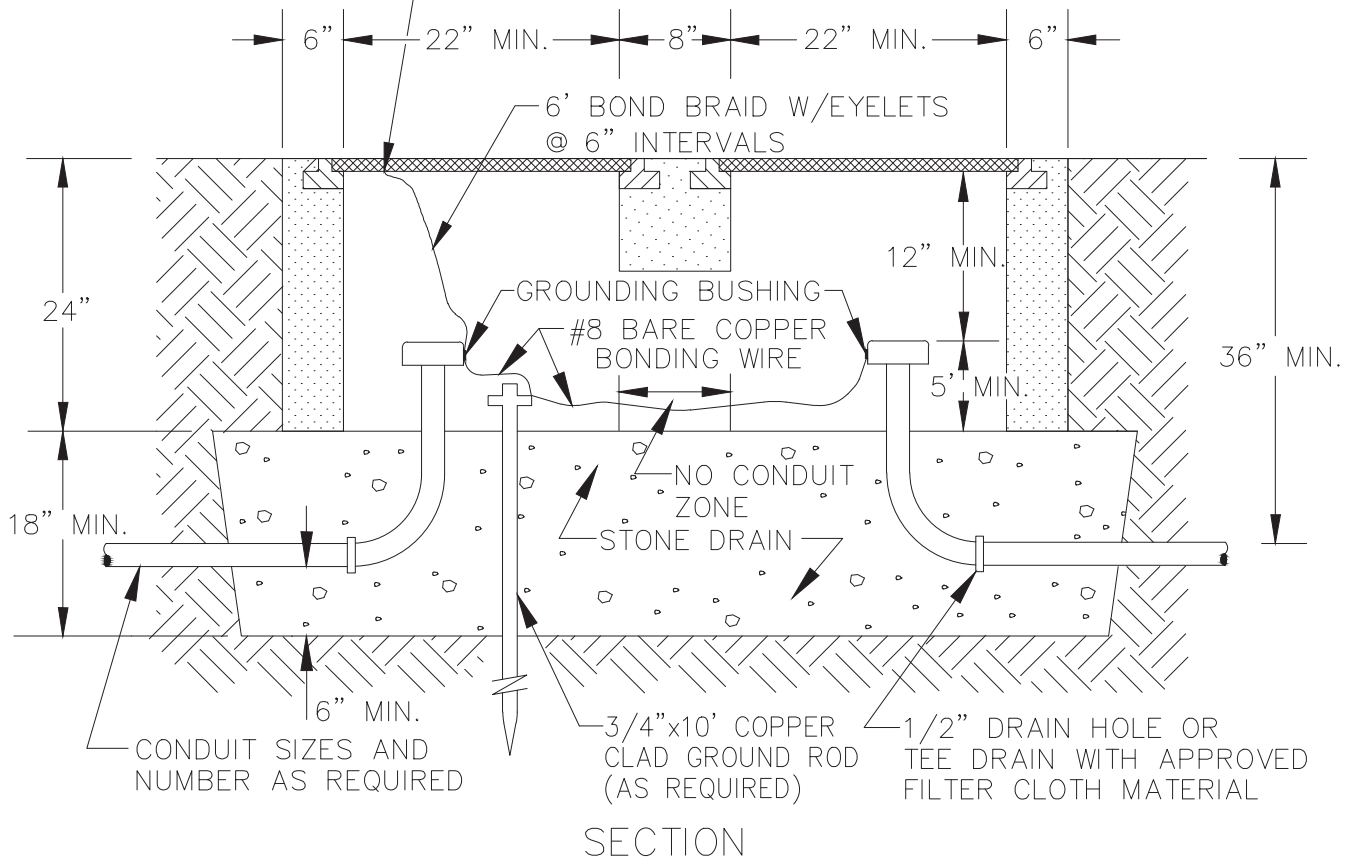
TYPE II JUNCTION BOX

SECTION #
80.08
 DETAIL #
80-32



EMBOSSED WITH "TRAFFIC" OR "LIGHTING" AS REQUIRED

ATTACH GROUND BRAID TO LID USING STAINLESS STEEL NUT AND BOLT



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SCALE:
N.T.S.

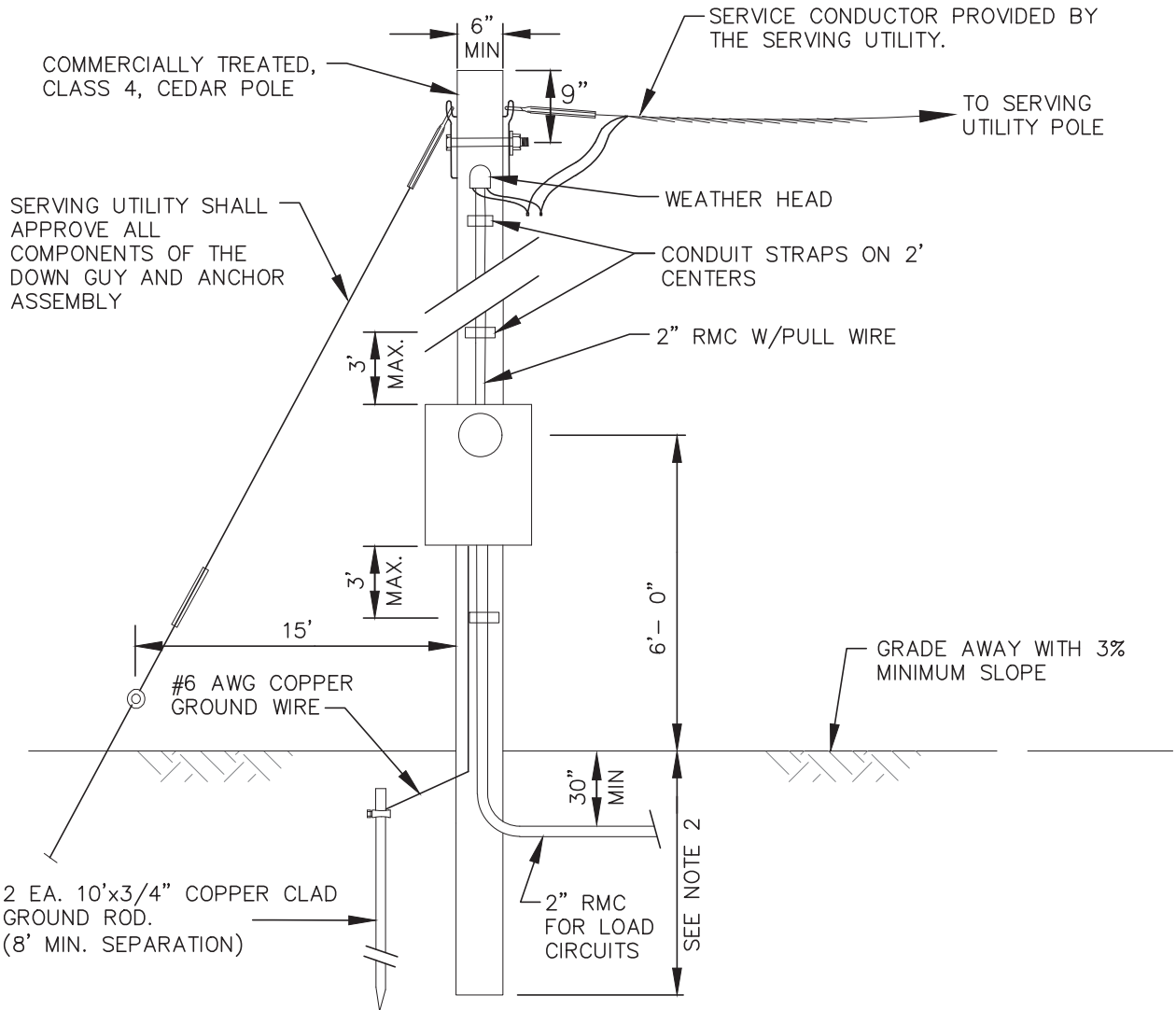
APPROVED:

REVISED:
2/24

TYPE III JUNCTION BOX

SECTION #
80.08

DETAIL #
80-33



NOTES:

1. COORDINATE WITH SERVING UTILITY REGARDING SPECIFIC CONSTRUCTION REQUIREMENTS FOR SERVICE.
2. SET THE BUTT END OF TYPE 3 LOAD CENTER POLES TO THE FOLLOWING MINIMUM DEPTH:
 - A. 10 PERCENT OF ITS LENGTH PLUS 2 FEET, OR 5 FEET, WHICHEVER IS GREATER, IF IT IS INSTALLED IN EARTH OTHER THAN SOLID ROCK OR MUSKEG.
 - B. 10 PERCENT OF ITS LENGTH, OR 4 FEET, WHICHEVER IS GREATER, IF IT IS INSTALLED IN SOLID ROCK.
 - C. CONSIDER MUSKEG TO BE AIR, AND SET THE BUTT ENDS TO THE DEPTH GIVEN IN A OR B, WHICHEVER APPLIES, IN THE UNDERLYING EARTH OR ROCK.
3. WHENEVER MORE THAN TWO FEET OF EARTH OVERLAYS ROCK, OR THE DIAMETER OF THE DRILLED HOLE IN ROCK EXCEEDS TWICE THE DIAMETER OF THE POLE AT THE GROUND LINE, CONSIDER THE INSTALLATION AS EARTH.

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

SCALE:
N.T.S.

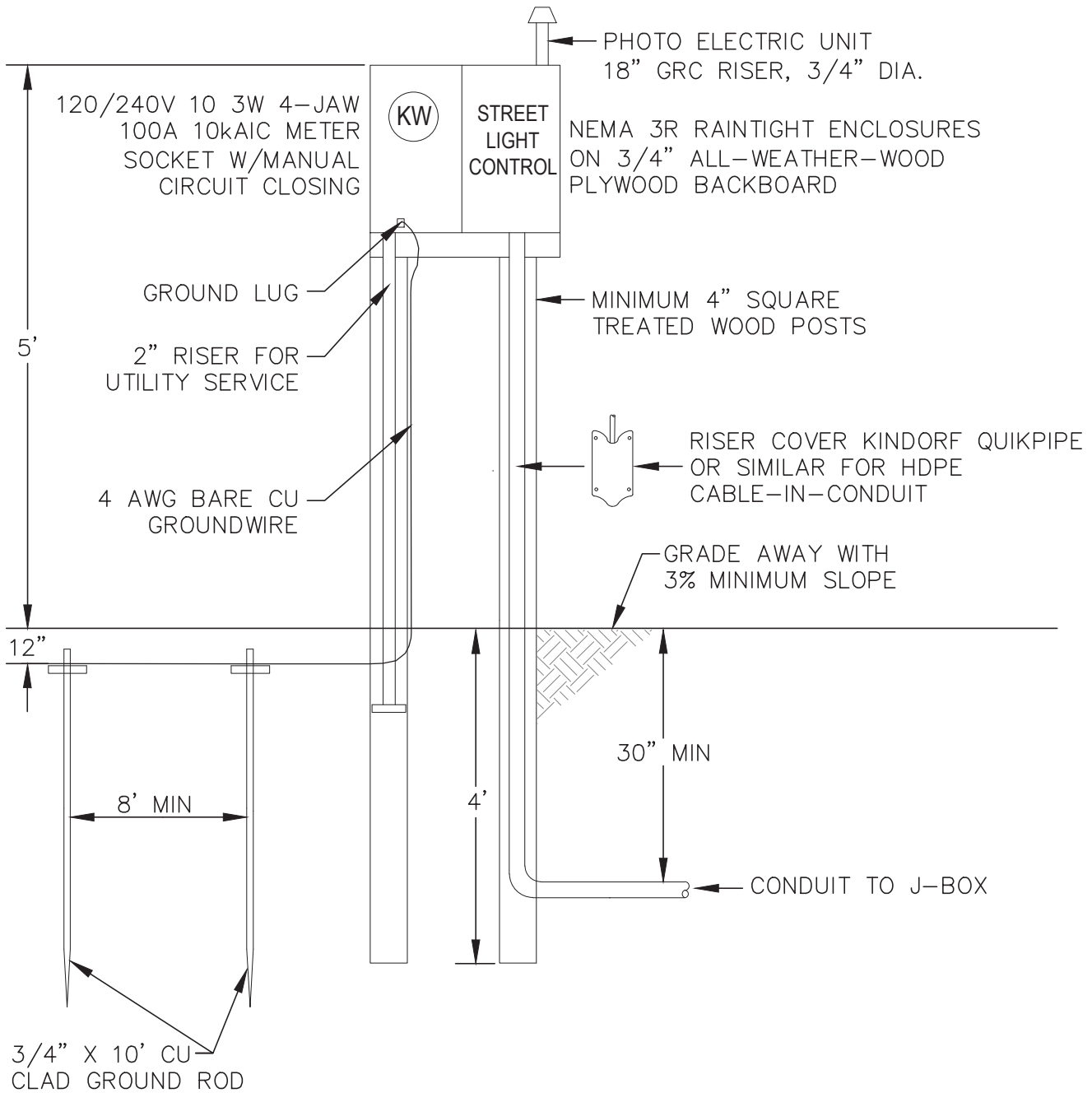
APPROVED:

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2/24

POST MOUNTED LOAD CENTER - TYPE 3

SECTION #
80.14

DETAIL #
80-34



NOTES:

1. ATTACH GROUND WIRE TO POLE AT 12" INTERVALS.
2. LOCATE OUT OF DITCH LINE, 5 FT. MINIMUM FROM BACK OF CURB.
3. COORDINATE WITH SERVING UTILITY REGARDING SPECIFIC CONSTRUCTION REQUIREMENTS FOR SERVICE.
4. MARK CONTROL PANEL TO WARN QUALIFIED PERSONS OF POTENTIAL ELECTRIC ARC FLASH HAZARDS DURING EXAMINATION, ADJUSTMENT, SERVICING AND/OR MAINTENANCE OF EQUIPMENT. MARKING MUST BE CLEARLY VISIBLE.

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

SCALE:
N.T.S.

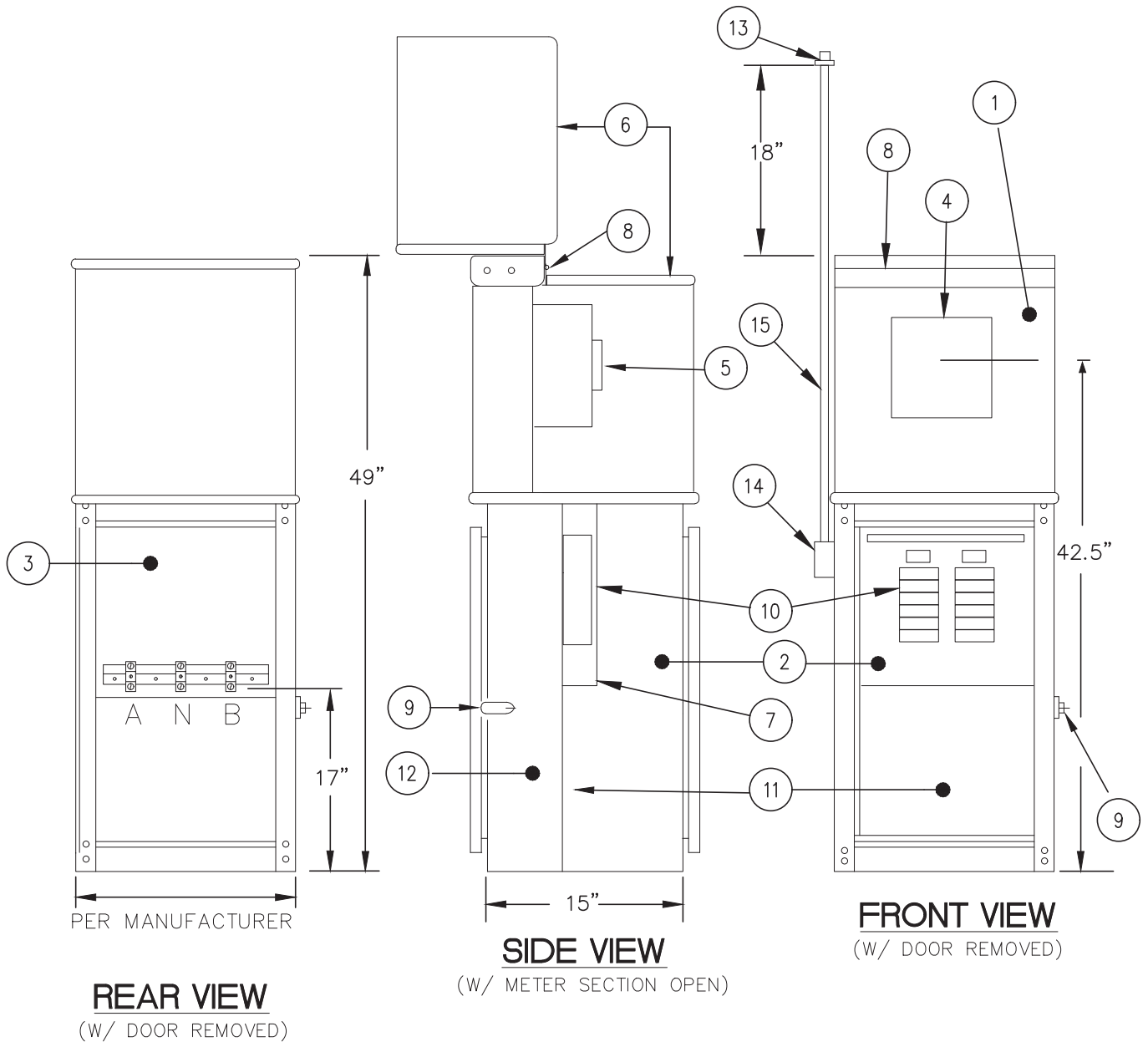
APPROVED:

REVISED:
2/24

POST MOUNTED LOAD CENTER - TYPE 2

SECTION #
80.14

DETAIL #
80-35



EQUIPMENT LEGEND/DESCRIPTION

- | | | |
|--|--|--|
| 1. METERING SECTION | 7. DEADFRONT | 13. PHOTOCELL |
| 2. LOAD SECTION | 8. STAINLESS STEEL PIN HINGE | 14. WEATHERTIGHT LB |
| 3. UTILITY CONNECTION AND TEST BLOCK SECTION | 9. PADLOCKING PROVISIONS | 15. 3/4" GRC CONDUIT, STRAP ON 24" CENTERS |
| 4. METER READING WINDOW (8"x8") | 10. DISTRIBUTION PANEL W/ MAIN BREAKER | |
| 5. METER SOCKET W/BYPASS & SAFETY SOCKET | 11. ACCESSORY MOUNTING EQUIPMENT AREA | |
| 6. LIFT AWAY METER SECTION COVER | 12. SERVICE PULL SECTION | |

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

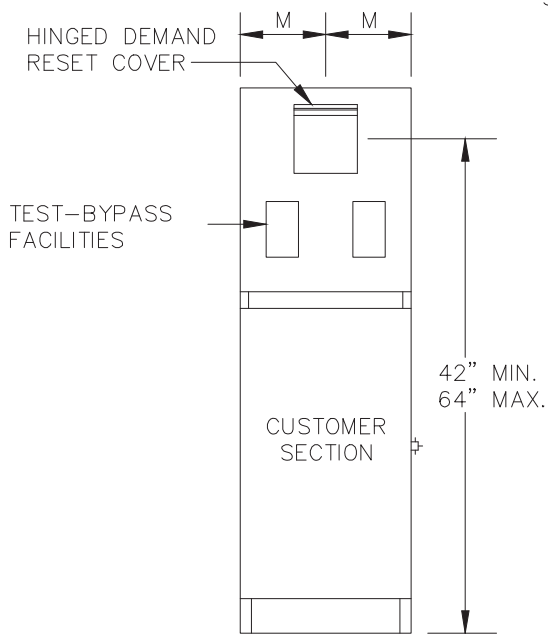
REVISED:
2/24

**LOAD CENTER ENCLOSURE
TYPE 1A**

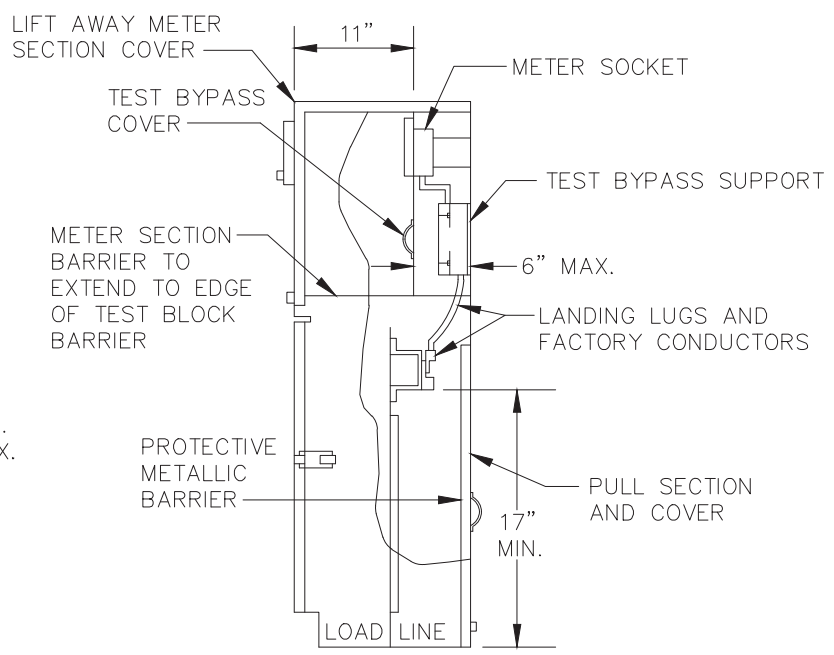
SECTION #
80.14

DETAIL #
80-36

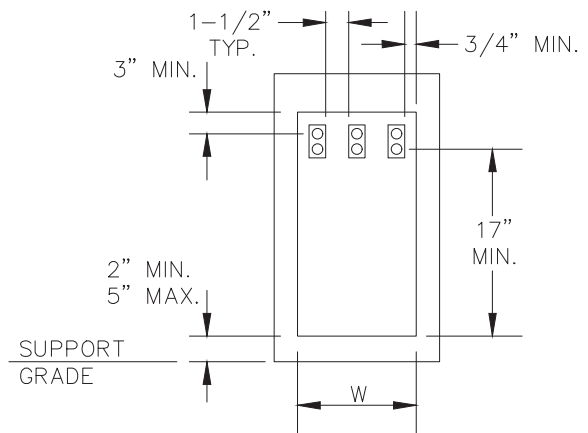
REVISION: 2024 M.A.S.S. UPDATE



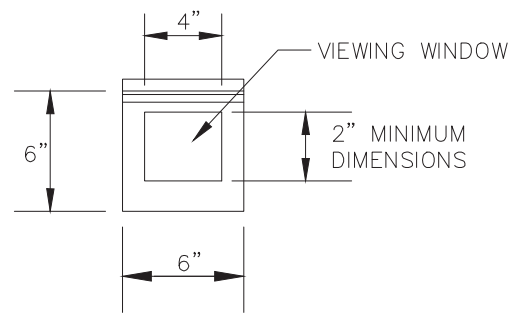
FRONT VIEW



SIDE VIEW



WIREWAY PULL SECTION



HINGED DEMAND RESET WITH POLYCARBONATE VIEWING

MINIMUM DIMENSIONS

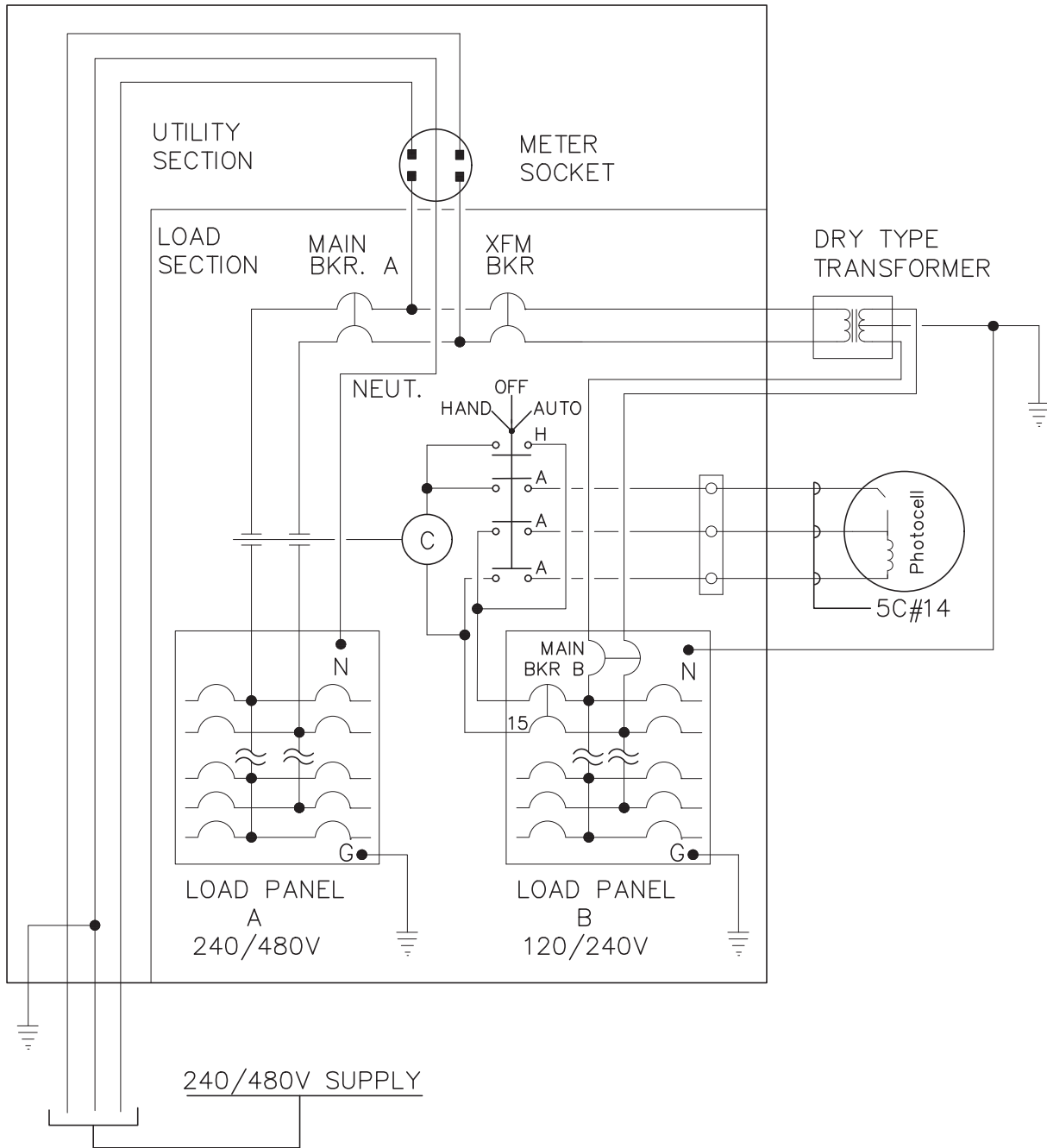
SERVICE	W	A
1 PHASE	10-1/2"	10"
3 PHASE	12-1/2"	



SCALE:
N.T.S.
APPROVED:
REVISED:
2/24

**LOAD CENTER ENCLOSURE
TYPE 1**

SECTION #
80.14
DETAIL #
80-37



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-39

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

LOAD CENTER WIRING DIAGRAM "A"

SECTION #
80.14

DETAIL #
80-38

LOAD CENTER NO. _____ TYPE _____

LOCATION _____

240/480 VOLTS, SINGLE PHASE, _____ AMP SUPPLY

_____ AMPS INTERRUPTING CURRENT

MAIN BREAKER A : 2 POLE, _____ AMPS, 480 VOLTS

MAIN BREAKER B : 2 POLE, _____ AMPS, 240 VOLTS

CONTACTOR RATING: _____ AMPS

TRANSFORMER RATING: 120/240-240/480., _____ KVA

PANEL A _____ 240/480 VOLTS _____ SINGLE PHASE 3 WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

PANEL B _____ 120/240 VOLTS _____ SINGLE PHASE 3 WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
PHOTO CELL ↓	0.1	15 ↓	1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

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MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

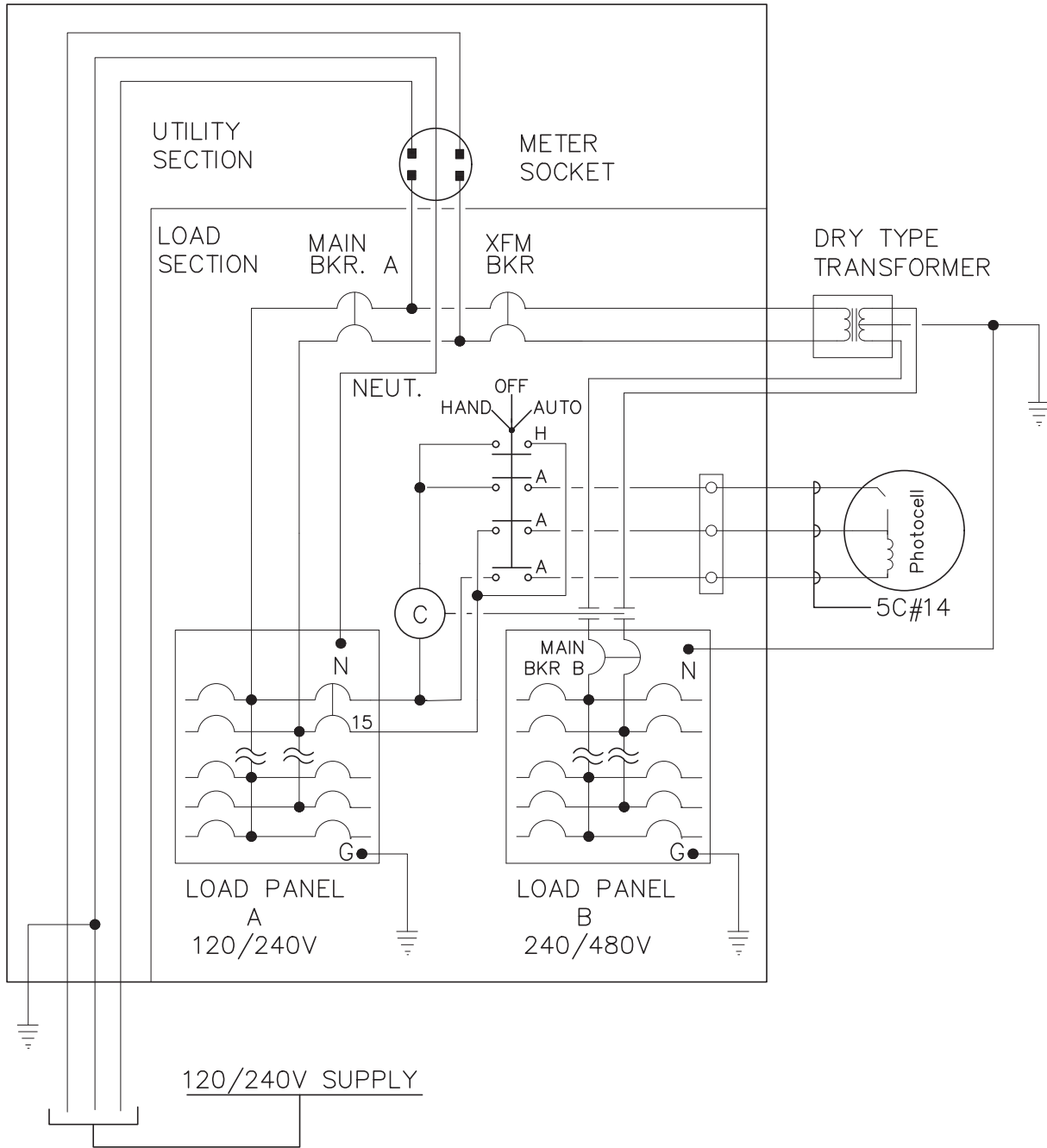
APPROVED:

REVISED:
2/24

PANEL SCHEDULE FOR WIRING DIAGRAM "A"

SECTION #
80.14

DETAIL #
80-39



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-41

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

LOAD CENTER WIRING DIAGRAM "B"

SECTION #
80.14

DETAIL #
80-40

LOAD CENTER NO. _____ TYPE _____
 LOCATION _____
 120/240 VOLTS, SINGLE PHASE, _____ AMP SUPPLY
 _____ AMPS INTERRUPTING CURRENT
 MAIN BREAKER A : 2 POLE, _____ AMPS, 240 VOLTS
 MAIN BREAKER B : 2 POLE, _____ AMPS, 480 VOLTS
 CONTACTOR RATING: _____ AMPS,
 TRANSFORMER RATING: 120/240-240/480., _____ KVA

PANEL A _____ 120/240 VOLTS _____ SINGLE PHASE _____ 3 WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
PHOTO CELL	0.1	15	1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

PANEL B _____ 240/480 VOLTS _____ SINGLE PHASE _____ 3 WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

REVISION: 2024 M.A.S.S. UPDATE

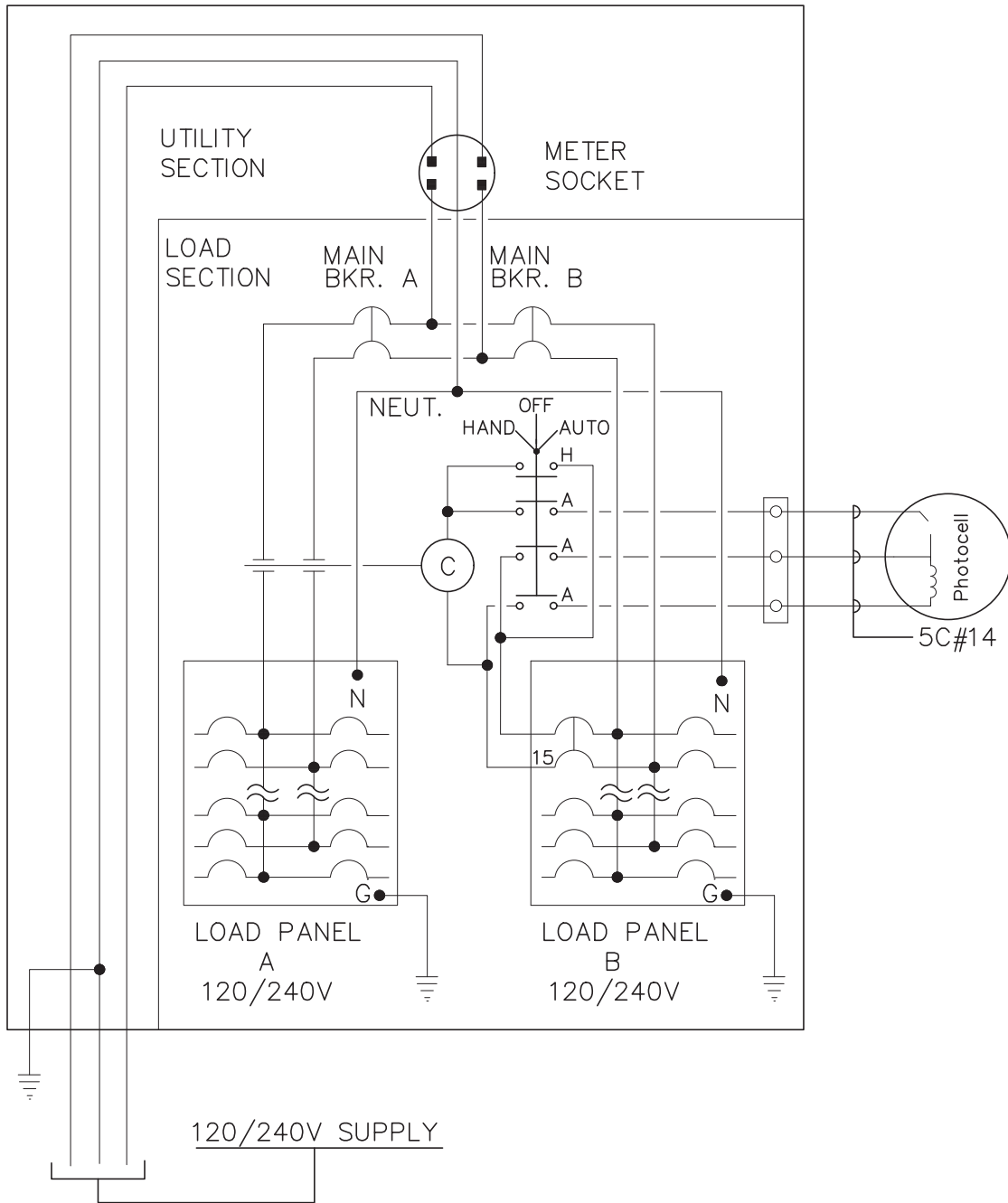
MUNICIPALITY

 OF ANCHORAGE

SCALE:
 N.T.S.
 APPROVED:
 REVISED:
 2/24

PANEL SCHEDULE FOR WIRING DIAGRAM "B"

SECTION #
 80.14
 DETAIL #
 80-41



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-43

REVISION: 2024 M.A.S.S. UPDATE

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OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

LOAD CENTER WIRING DIAGRAM "C"

SECTION #
80.14

DETAIL #
80-42

LOAD CENTER NO. _____ TYPE _____

LOCATION _____

120/240 VOLTS, SINGLE PHASE, _____ AMP SUPPLY
 _____ AMPS INTERRUPTING CURRENT

MAIN BREAKER A : 2 POLE, _____ AMPS, 240 VOLTS

MAIN BREAKER B : 2 POLE, _____ AMPS, 240 VOLTS

CONTACTOR RATING: _____ AMPS, 240 VOLTS

PANEL A _____ 120/240 VOLTS _____ SINGLE _____ PHASE _____ 3 _____ WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

PANEL B _____ 120/240 VOLTS _____ SINGLE _____ PHASE _____ 3 _____ WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
PHOTO CELL ↓	0.1	15 ↓	1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

REVISION: 2024 M.A.S.S. UPDATE

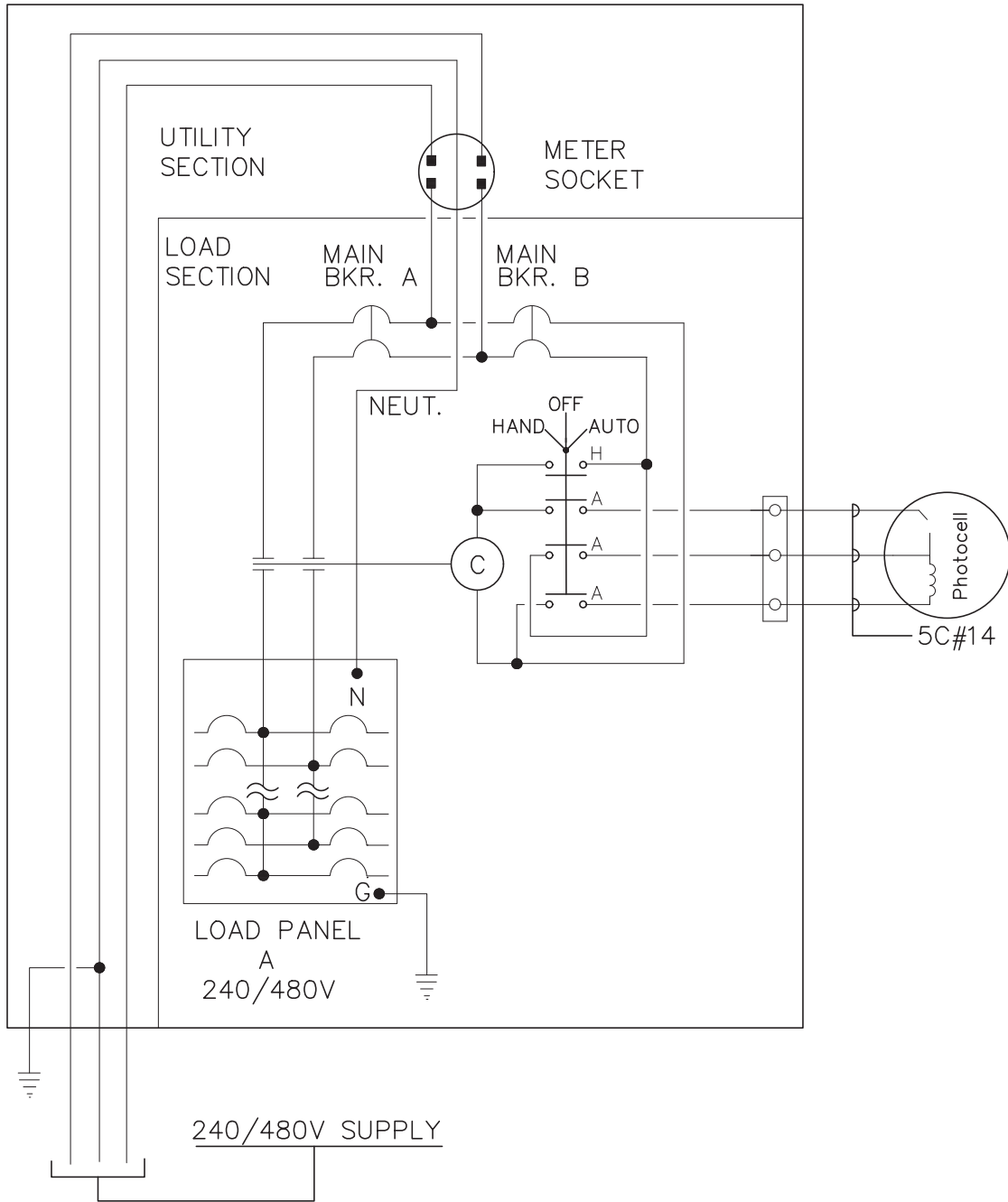
MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
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2/24

PANEL SCHEDULE FOR WIRING DIAGRAM "C"

SECTION #
80.14
 DETAIL #
80-43



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-45

REVISION: 2024 M.A.S.S. UPDATE

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OF ANCHORAGE

SCALE:
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APPROVED:

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2/24

LOAD CENTER WIRING DIAGRAM "D"

SECTION #
80.14

DETAIL #
80-44

LOAD CENTER NO. _____ TYPE _____

LOCATION _____

240/480 VOLTS, SINGLE PHASE, _____ AMP SUPPLY

_____ AMPS INTERRUPTING CURRENT

MAIN BREAKER A : 2 POLE, _____ AMPS, 480 VOLTS

MAIN BREAKER B : 1 POLE, _____ 15 _____ AMPS, 240 VOLTS

CONTACTOR RATING: _____ AMPS, 240 VOLTS

PANEL A _____ 240/480 VOLTS _____ SINGLE _____ PHASE _____ 3 _____ WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

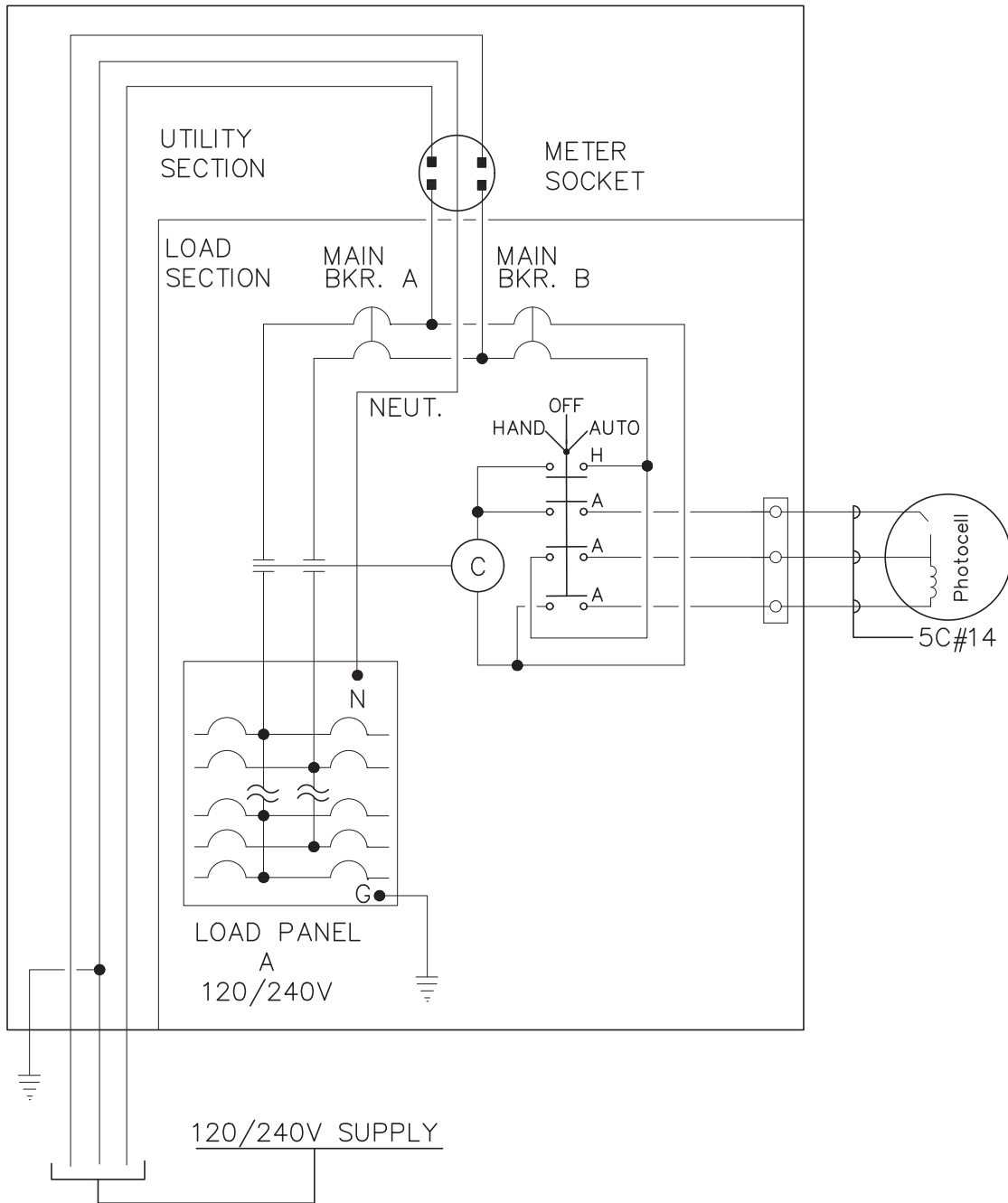
REVISION: 2024 M.A.S.S. UPDATE



SCALE:
N.T.S.
APPROVED:
REVISED:
2/24

PANEL SCHEDULE FOR WIRING DIAGRAM "D"

SECTION #
80.14
DETAIL #
80-45



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-47

REVISION: 2024 M.A.S.S. UPDATE



SCALE:
N.T.S.

APPROVED:

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2/24

LOAD CENTER WIRING DIAGRAM "E"

SECTION #
80.14

DETAIL #
80-46

LOAD CENTER NO. _____ TYPE: _____
 LOCATION: _____
 120/240 VOLTS, SINGLE PHASE, _____ AMP SUPPLY
 _____ AMPS INTERRUPTING CURRENT
 MAIN BREAKER A : 2 POLE, _____ AMPS, 240 VOLTS
 MAIN BREAKER B : 2 POLE, _____ 15 _____ AMPS, 240 VOLTS
 CONTACTOR RATING: _____ AMPS

PANEL A _____ 120/240 VOLTS _____ SINGLE PHASE 3 WIRE
 _____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY

CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

REVISION: 2024 M.A.S.S. UPDATE

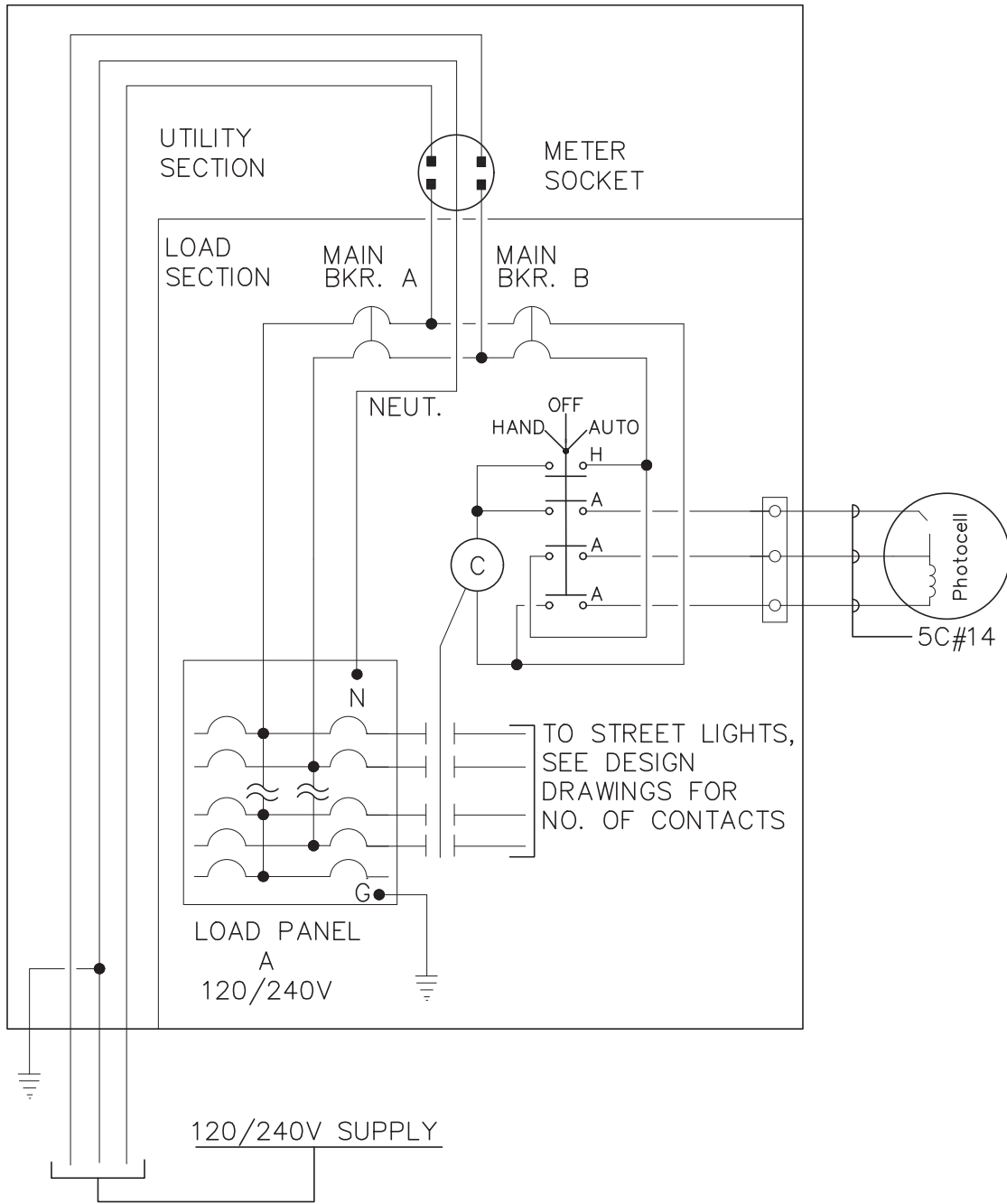
MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

PANEL SCHEDULE FOR WIRING DIAGRAM "E"

SECTION #
80.14
 DETAIL #
80-47



NOTE:

1. SEE PANEL SCHEDULE, STANDARD DETAIL 80-49

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

APPROVED:

REVISED:
2/24

LOAD CENTER WIRING DIAGRAM "F"

SECTION #
80.14

DETAIL #
80-48

LOAD CENTER NO. _____ TYPE: _____

LOCATION: _____

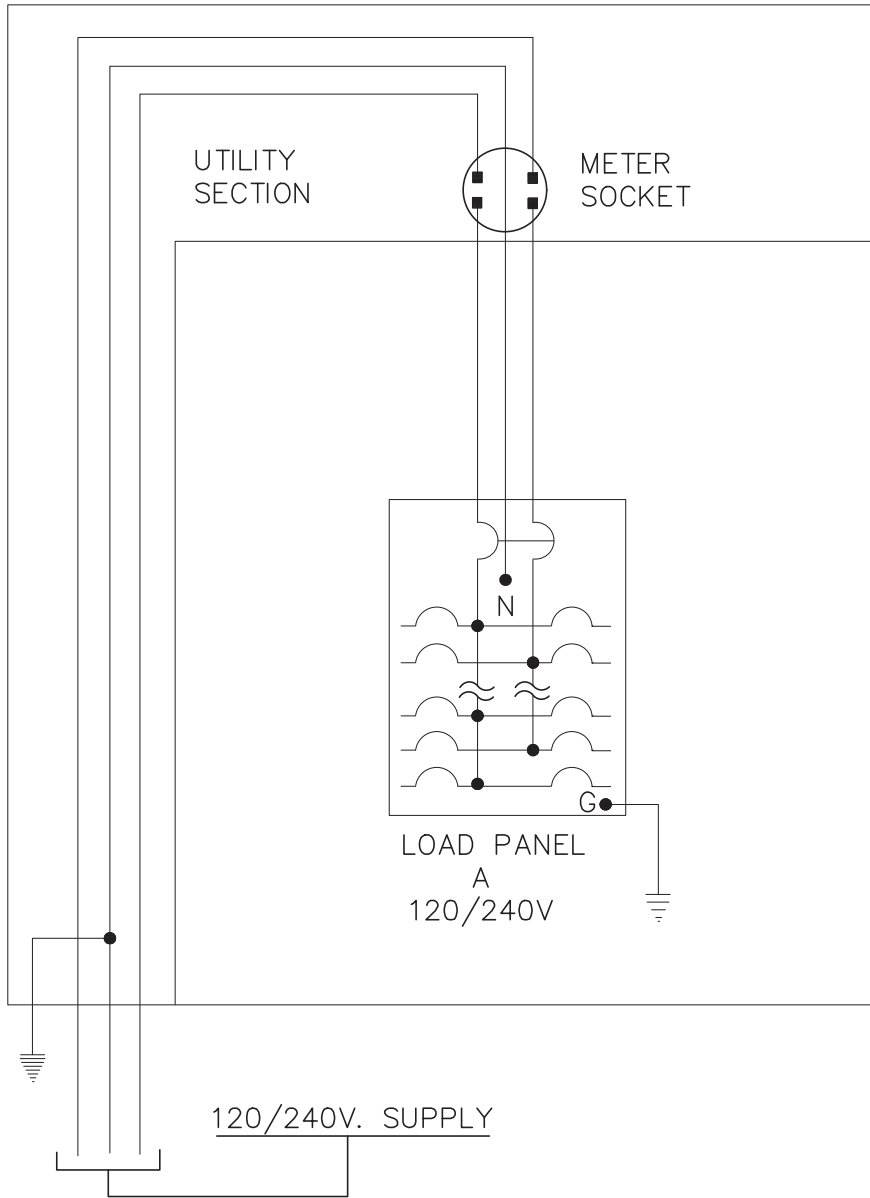
_____ POLE, _____ AMP CONTACTOR

PANEL A		_____ 120/240 _____ VOLTS _____ SINGLE _____ PHASE _____ 3 _____ WIRE		_____ AMPS MAIN LUGS, _____ AMPS INTERRUPT CAPACITY			
CKT. DESCRIPTION	KVA	AMP			AMP	KVA	CKT. DESCRIPTION
			1	2			
			3	4			
			5	6			
			7	8			
			9	10			
			11	12			
			13	14			
			15	16			
			17	18			
			19	20			

NOTE: SEE CONSTRUCTION DRAWINGS FOR NUMBER & SIZE OF BREAKERS.

REVISION: 2024 M.A.S.S. UPDATE

 <p>MUNICIPALITY OF ANCHORAGE</p>	<p>SCALE: N.T.S.</p> <p>APPROVED:</p> <p>REVISED: 2/24</p>	<p>PANEL SCHEDULE FOR WIRING DIAGRAM "F"</p>	<p>SECTION # 80.14</p> <p>DETAIL # 80-49</p>
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NOTE:

1. SEE PANEL SCHEDULE, DETAIL 80-51

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY



OF ANCHORAGE

SCALE:
N.T.S.

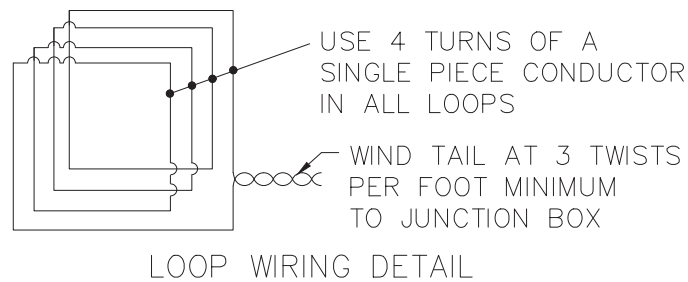
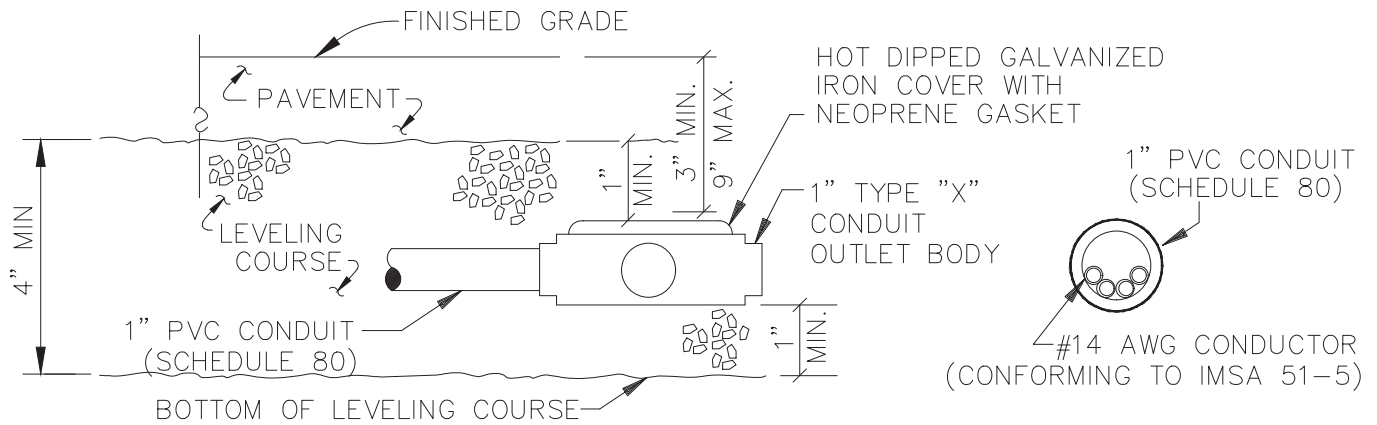
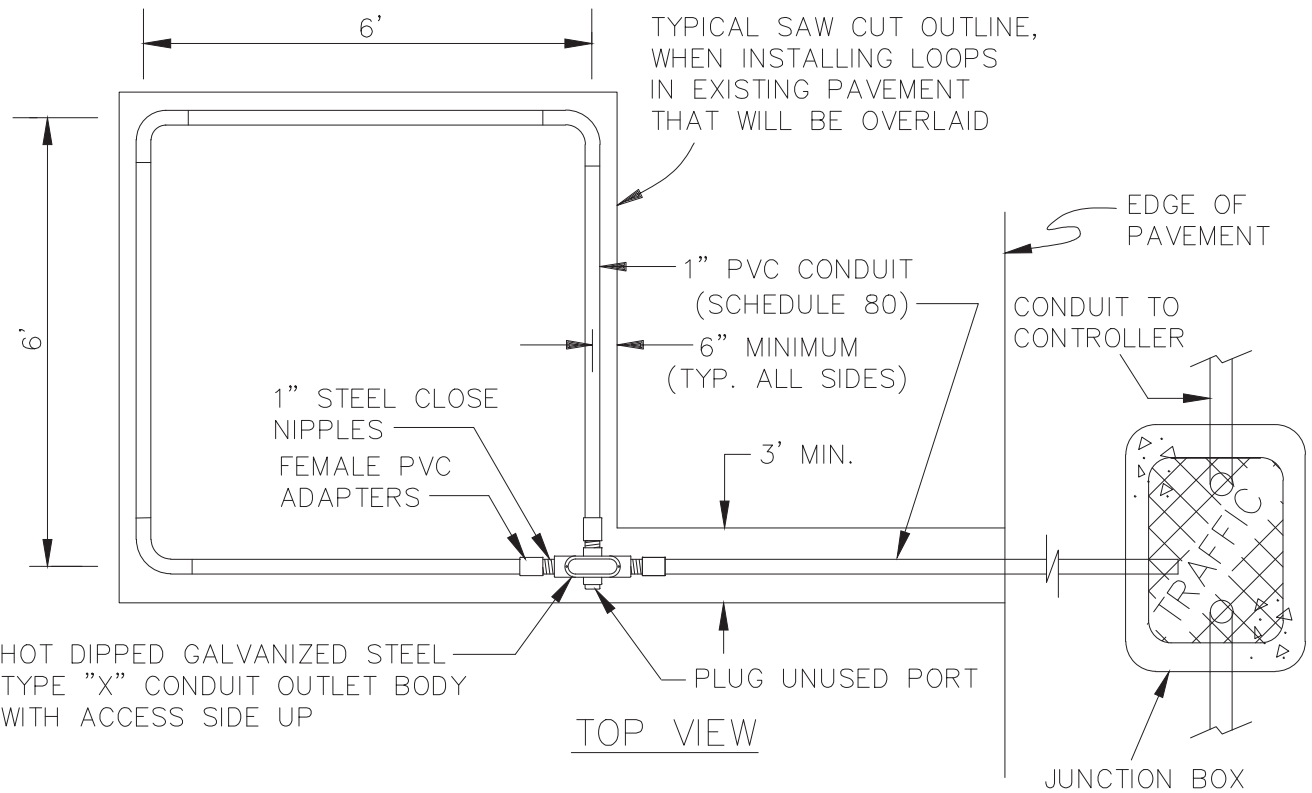
APPROVED:

REVISED:
2/24

LOAD CENTER WIRING DIAGRAM "G"

SECTION #
80.14

DETAIL #
80-50



REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

SCALE:
N.T.S.

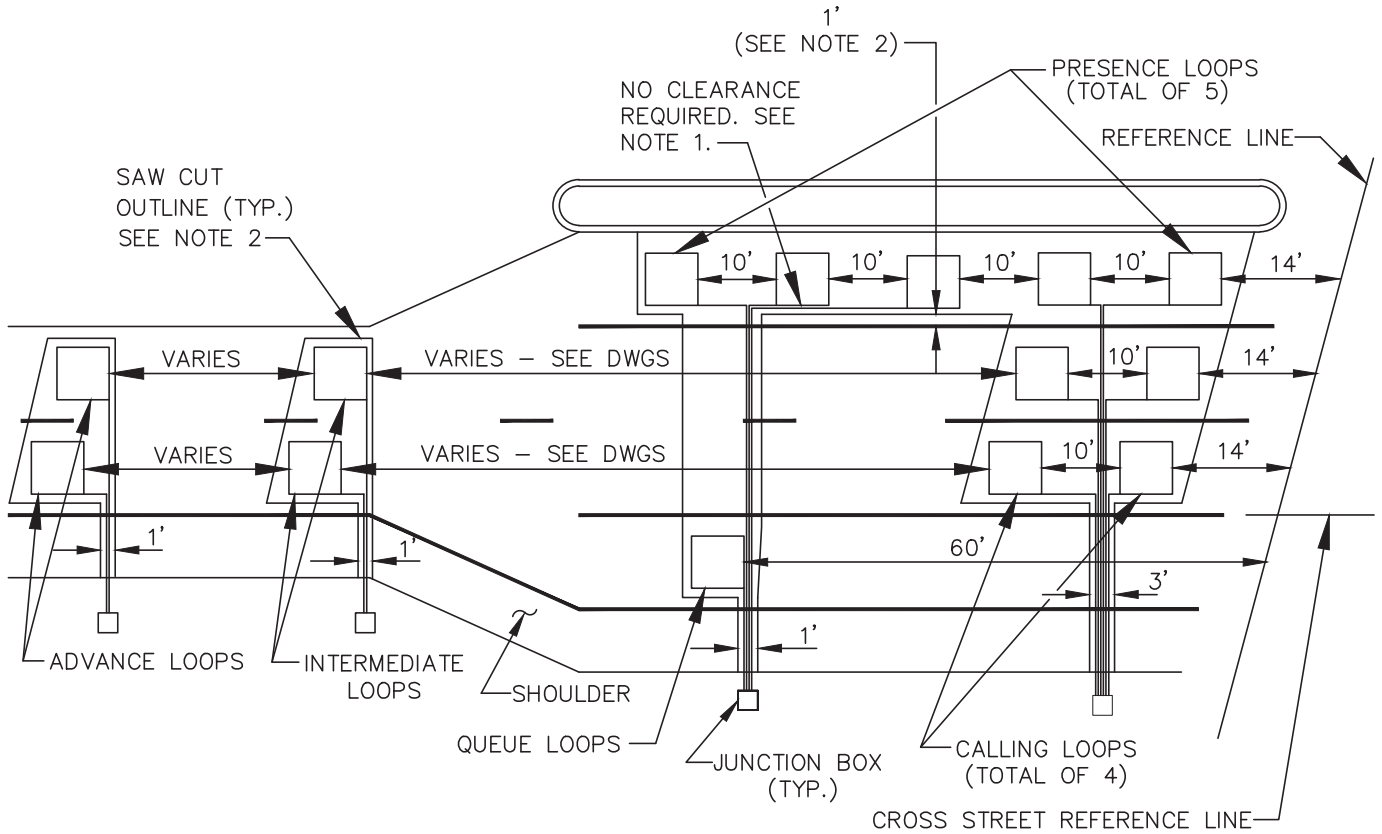
APPROVED:

REVISED:
2/24

CONDUIT ENCASED LOOP DETECTOR

SECTION #
80.18

DETAIL #
80-52



TYPICAL LOOP SETBACKS

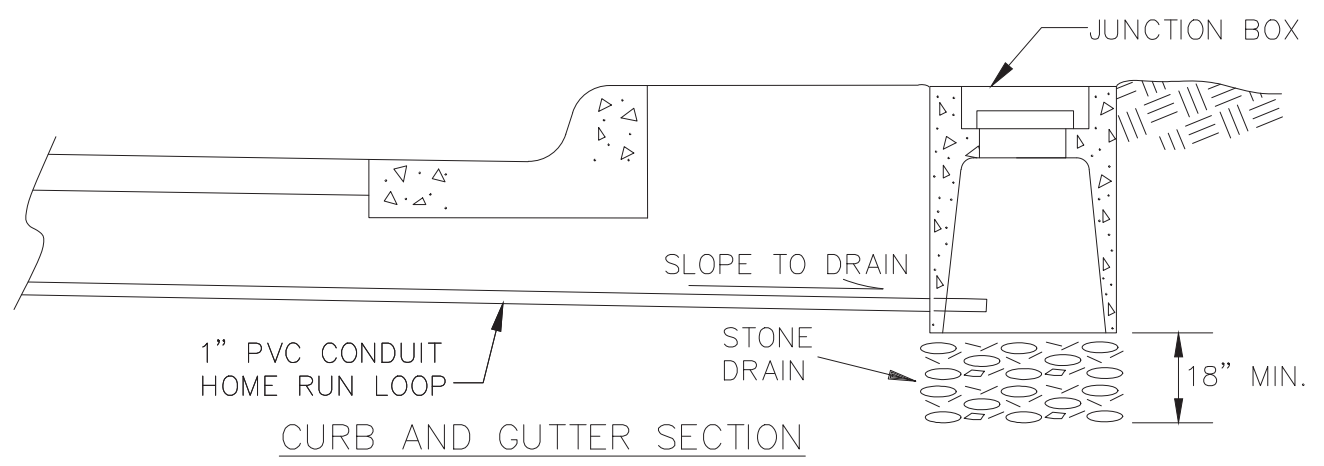
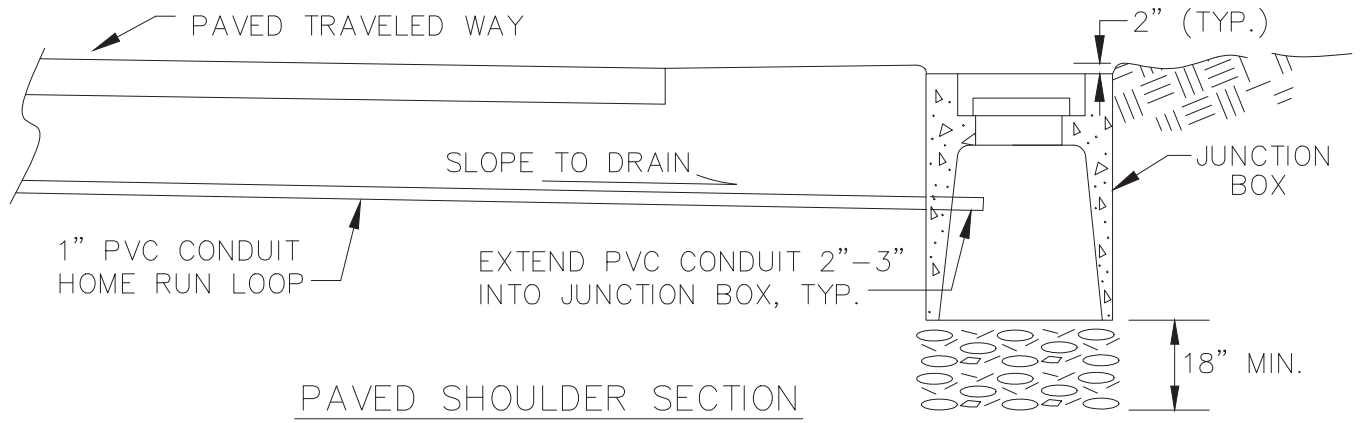
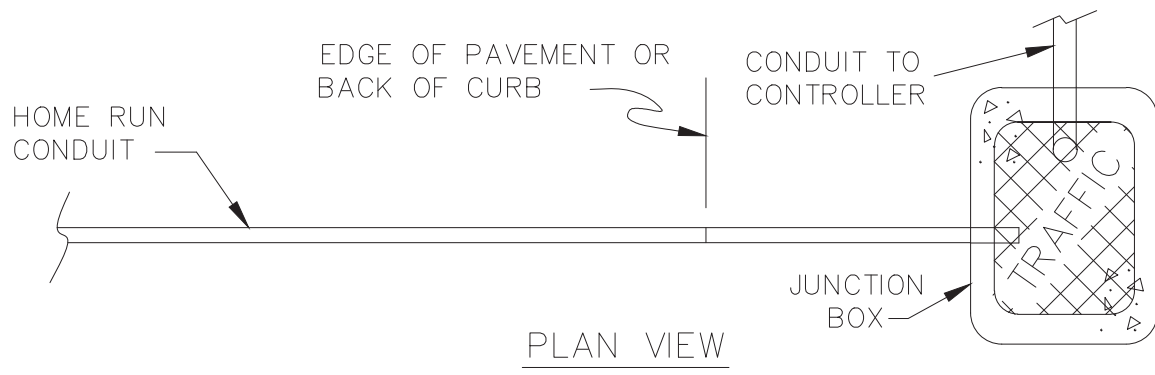
MEASURE THE SETBACKS FROM THE REFERENCE LINE
ALONG THE CENTER OF EACH LANE

NOTES:

1. NO MINIMUM CLEARANCE IS REQUIRED BETWEEN A DETECTOR LOOP AND HOMERUN LOOP WIRES OR BETWEEN HOMERUN LOOP WIRES. HOMERUN LOOP WIRES SHALL NOT CROSS LOOP CONDUITS.
2. WHERE EXISTING PAVEMENT WILL NOT BE OVERLAID, ENCLOSE ALL LOOPS THAT ENTER A COMMON JUNCTION BOX WITHIN A TRAPEZOIDAL SAW CUT. CUT TO WITHIN 1 FOOT OF THE LANE AND EDGE LINES, PRESERVING THESE PAVEMENT MARKINGS; REMOVE THE ASPHALT TO THE LIP OF THE GUTTER WHEN THERE ARE NO EDGE LINES. CUT ACROSS LANE LINES WHEN LOOPS IN ADJACENT LANES ARE SIDE BY SIDE. CUT TRENCHES A MINIMUM OF 3 FEET WIDE WHEN INSTALLING LOOP TAILS ACROSS A LANE; CUT TRENCHES A MINIMUM 1 FOOT WIDE WHEN CROSSING A SHOULDER.

REVISION: 2024 M.A.S.S. UPDATE

 MUNICIPALITY OF ANCHORAGE	SCALE: N.T.S. APPROVED: REVISED: 2/24	<h2 style="margin: 0;">LOOP DETECTOR INSTALLATION DETAILS</h2>	SECTION # 80.18 DETAIL # 80-53
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REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

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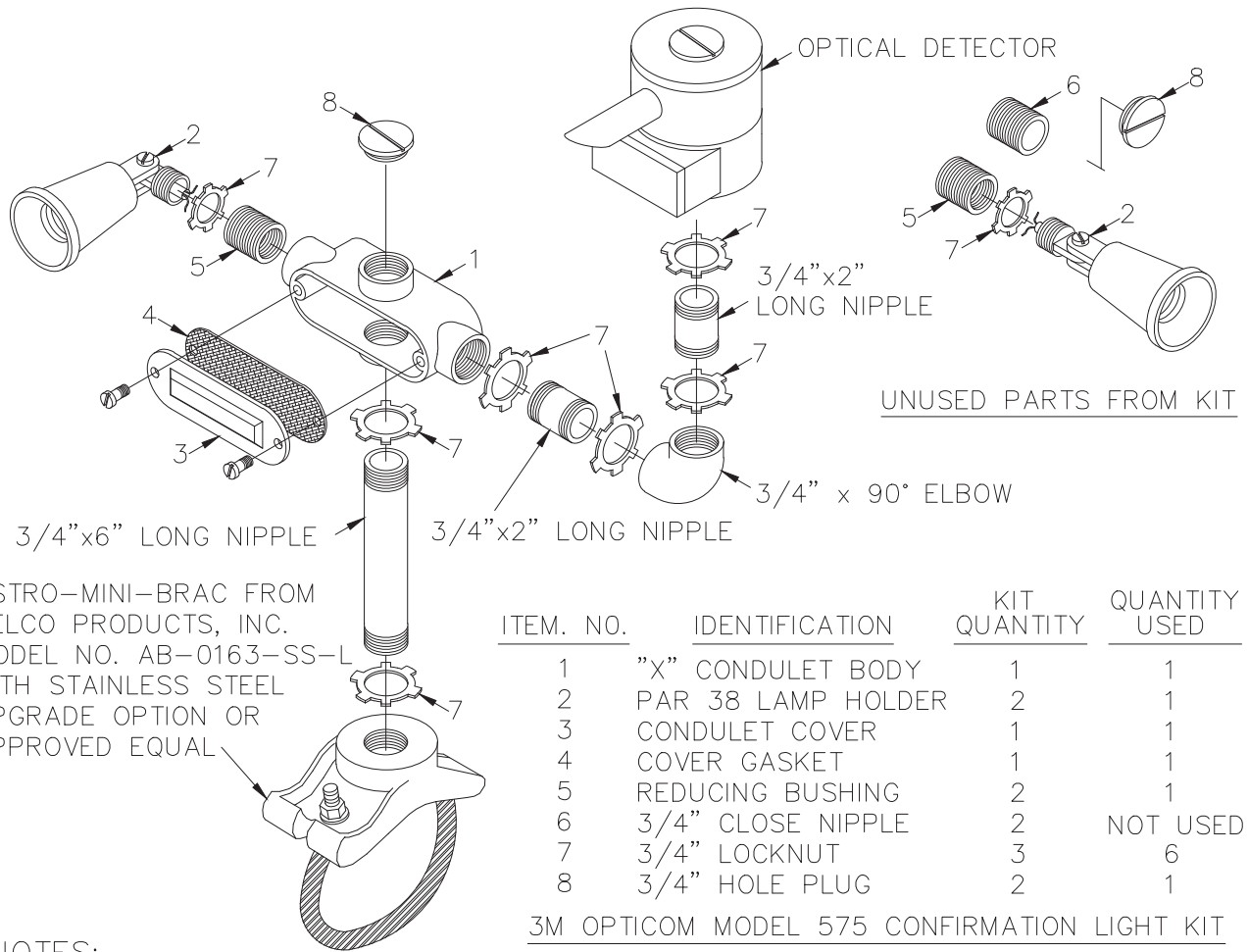
APPROVED:

REVISED:
2/24

LOOP DETECTOR HOME RUN

SECTION #
80.18

DETAIL #
80-54



ASTRO-MINI-BRAC FROM
 PELCO PRODUCTS, INC.
 MODEL NO. AB-0163-SS-L
 WITH STAINLESS STEEL
 UPGRADE OPTION OR
 APPROVED EQUAL

ITEM. NO.	IDENTIFICATION	KIT QUANTITY	QUANTITY USED
1	"X" CONDULET BODY	1	1
2	PAR 38 LAMP HOLDER	2	1
3	CONDULET COVER	1	1
4	COVER GASKET	1	1
5	REDUCING BUSHING	2	1
6	3/4" CLOSE NIPPLE	2	NOT USED
7	3/4" LOCKNUT	3	6
8	3/4" HOLE PLUG	2	1

3M OPTICOM MODEL 575 CONFIRMATION LIGHT KIT

NOTES:

- SEE THE SIGNAL PLANS FOR THE SIGNAL MAST ARMS SCHEDULED FOR OPTICOM DETECTOR INSTALLATION.
- FOR EACH OPTICOM INSTALLATION, FURNISH THE FOLLOWING PARTS:
 - A 3M MODEL 711, 721, OR 722 OPTICOM DETECTOR AS SHOWN ON THE PLANS.
 - A 3M MODEL 575 CONFIRMATION LIGHT KIT, OR AN APPROVED EQUAL, THAT CONSISTS OF STEEL PARTS WITH A HOT DIP GALVANIZED FINISH.
 - A 3/4"x6" LONG PIPE NIPPLE, TWO 3/4"x2" LONG NIPPLES, AND A 3/4" 90° PIPE ELBOW. FURNISH PARTS WITH A HOT DIPPED GALVANIZED FINISH.
 - THREE ADDITIONAL 3/4" LOCKNUTS WITH ZINC PLATED FINISH.
 - AN ASTRO-MINI-BRAC, MODEL AB-0163-SS-L, MANUFACTURED BY PELCO PRODUCTS, OR AN APPROVED EQUAL.
 - A 20 WATT, PAR 38, LED FLOOD LAMP RATED FOR 120 VOLT OPERATION, 1250 INITIAL LUMENS, AND A 25000 HOUR LAMP LIFE.
- DRILL A 1" HOLE IN THE TOP DEAD CENTER OF THE MAST ARM AT THE OPTICOM DETECTORS PRE-APPROVED LATERAL LOCATION. ASSEMBLE THE PARTS AS SHOWN ON THIS SHEET.
- BEFORE ATTACHING THE MODEL 138 DETECTOR CABLE TO THE OPTICOM DETECTOR, STRIP 1" OF THE INSULATION FROM THE THREE INSULATED CONDUCTORS AT THE CONTROLLER CABINET AND ATTACH ALL FOUR CONDUCTORS TO GROUND.

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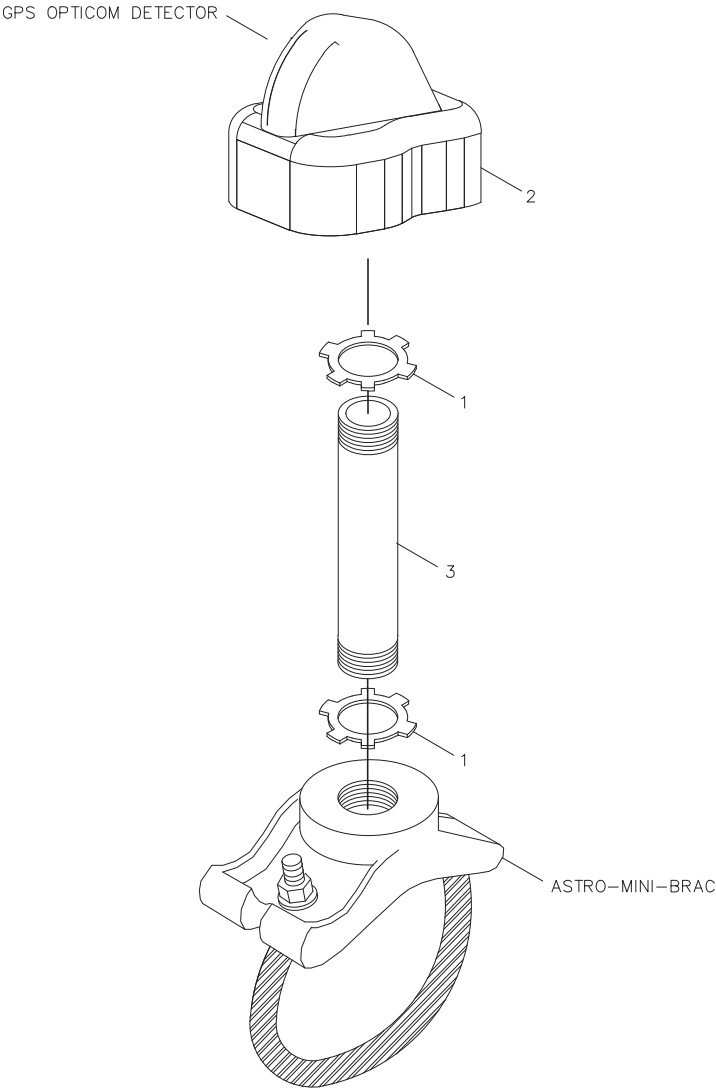
OPTICOM DETECTOR INSTALLATION DETAILS

SECTION #
 80.18

DETAIL #
 80-55A

NOTES:

1. SEE THE SIGNAL PLANS FOR THE SIGNAL POLE MAST ARM SCHEDULED FOR GPS OPTICOM SYSTEM INSTALLATION.
2. FOR EACH GPS OPTICOM SYSTEM INSTALLATION, FURNISH:
 - A. A GTT MODEL 3100 GPS DETECTOR AS CALLED FOR IN PLANS.
 - B. AN ASTRO-MINI-BRAC, MODEL AB-0163-SS-L, AS MANUFACTURED BY PELCO PRODUCTS OR AN APPROVED EQUAL.
3. MOUNT DETECTORS PER MANUFACTURER RECOMMENDATIONS. DRILL A 1 INCH HOLE IN THE TOP DEAD CENTER OF THE MAST ARM AT THE LOCATION PRE-APPROVED BY THE ENGINEER. ASSEMBLE AND TIGHTEN THE PARTS AND LOCKNUTS AS SHOWN ON THIS SHEET.
4. INSTALL OPTICOM MODEL 1070 GPS INSTALLATION CABLE BETWEEN THE SIGNAL CABINET AND THE GPS UNIT PER MANUFACTURER RECOMMENDATIONS. LEAVE APPROXIMATELY 10 FEET OF THE MODEL 1070 CABLE SPOOLED IN THE TRAFFIC CONTROLLER CABINET.
5. PREEMPTION EMITTERS SHALL BE ASSIGNED ID NUMBERS BY JURISDICTION AS SHOWN IN VEHICLE EMITTER TABLE.



PARTS LIST FOR EACH GPS OPTICOM DETECTOR INSTALLED

GTT OPTICOM MODEL 3100 RADIO/GPS UNIT AS SHOWN FROM PARTS BELOW

PART NO.	PART TYPE	LIGHT KIT QUANTITY
1	3/4" LOCKNUT	2
2	GPS OPTICOM UNIT	1
3	3/4" X 6" NIPPLE	1

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MUNICIPALITY



OF ANCHORAGE

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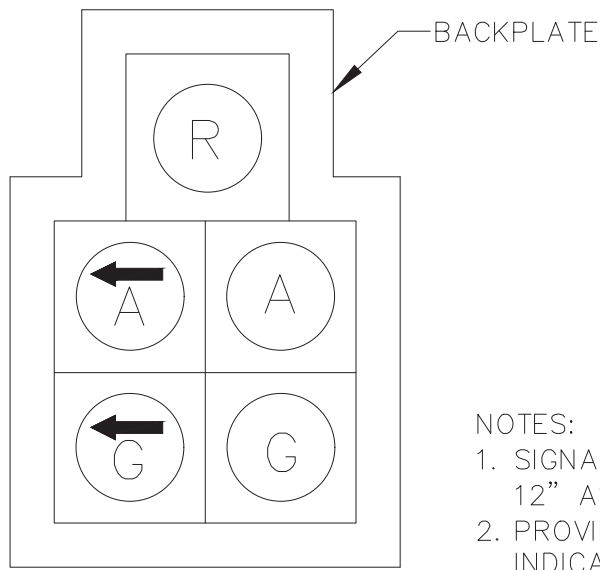
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2/24

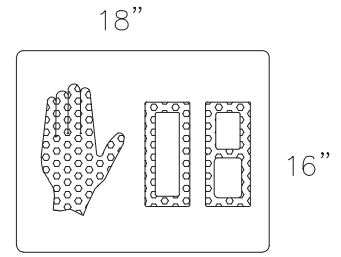
GPS OPTICOM DETECTOR INSTALLATION DETAILS

SECTION #
80.18

DETAIL #
80-55B



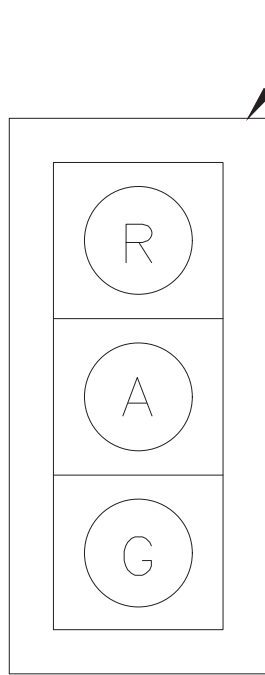
5-LENS HEAD



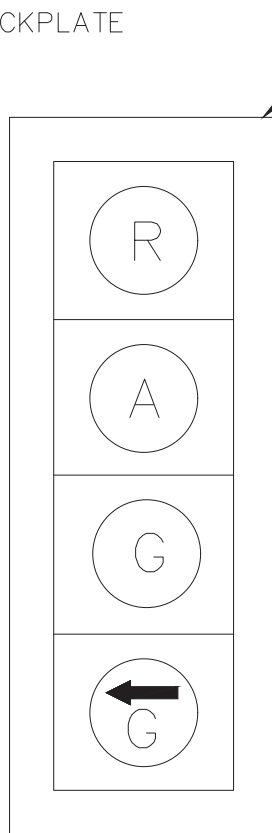
PEDESTRIAN HEAD

NOTES:

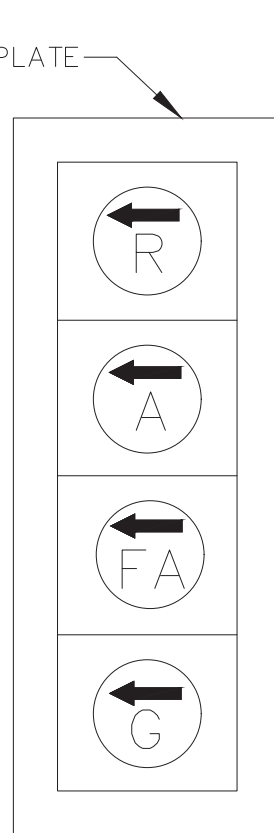
1. SIGNAL FACE DIMENSIONS ARE 8" OR 12" AS SPECIFIED IN THE DRAWINGS.
2. PROVIDE LEFT/RIGHT ARROW INDICATIONS, AS INDICATED IN THE CONTRACT DOCUMENTS.
3. ALL VEHICLE SIGNALS SHALL HAVE BACKPLATES.



3-LENS HEAD



4-LENS HEAD



FLASHING YELLOW HEAD

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MUNICIPALITY



OF ANCHORAGE

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2/24

SIGNAL HEADS

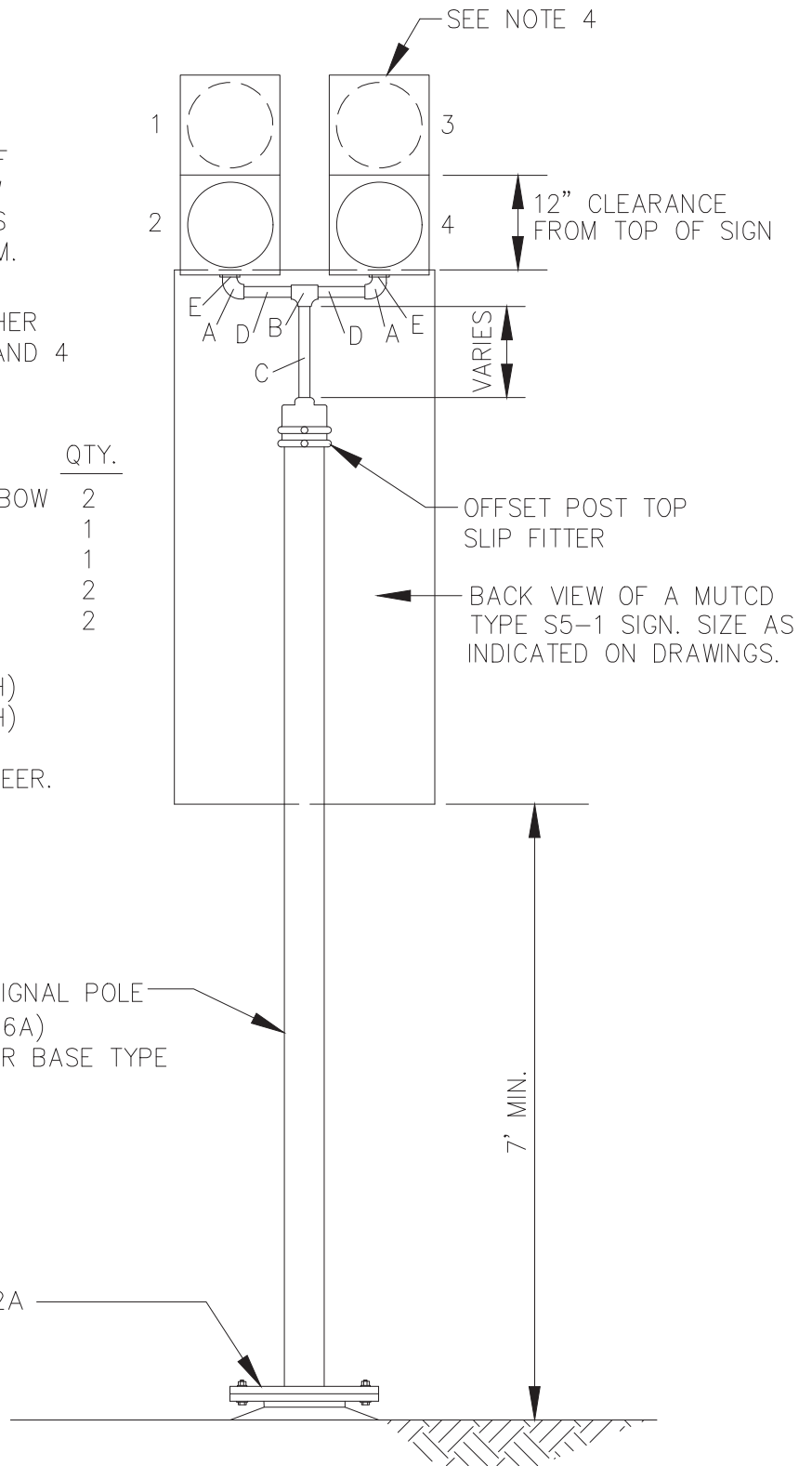
SECTION #
80.19 &
80.20

DETAIL #
80-56

SCHOOL FLASHER NOTES:

1. EACH FLASHER SHALL CONSIST OF FOUR SIGNAL FACES WITH YELLOW LENSES AND TUNNEL TYPE VISORS WITH OPEN SLOTS AT THE BOTTOM.
2. THE CONTRACTOR SHALL WIRE SIGNAL FACES 1 AND 2 ON FLASHER CIRCUIT 1 AND SIGNAL FACES 3 AND 4 ON FLASHER CIRCUIT 2.
3. BEACON FRAMEWORK

ITEM NO.	IDENTIFICATION	QTY.
A	1-1/2" 90° SERRATED ELBOW	2
B	1-1/2" TEE	1
C	1-1/2" x VARIES NIPPLE	1
D	1-1/2" x VARIES NIPPLE	2
E	1-1/2" LOCK NIPPLE	2
4. YELLOW SIGNAL FACE:
 12" (POSTED SPEEDS ≥ 40 MPH)
 8" (POSTED SPEEDS ≤ 30 MPH)
 FOR 35 mph SIGNAL FACE SIZE REQUIRES DISCRETION OF ENGINEER.



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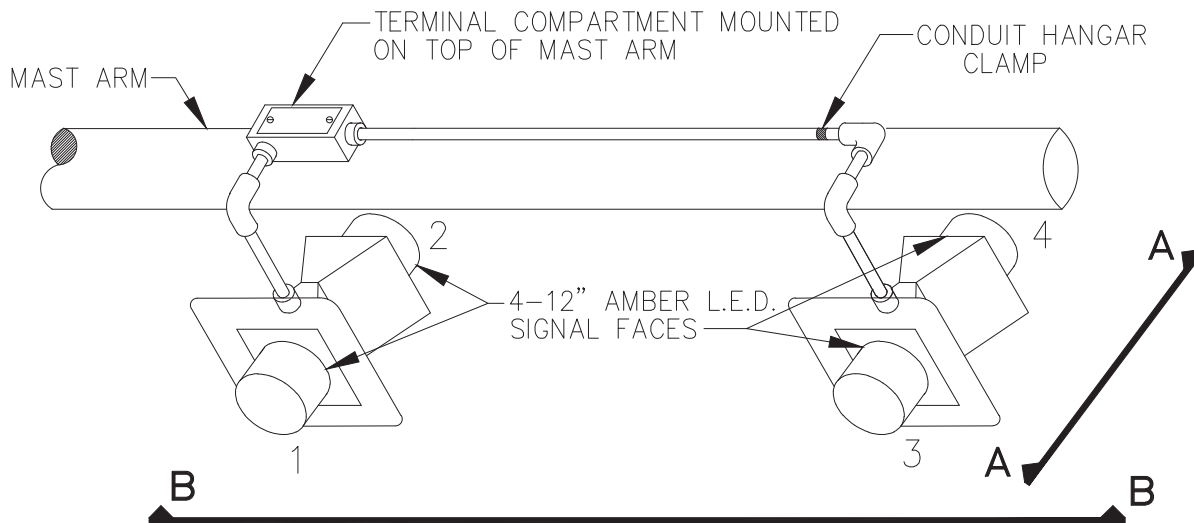


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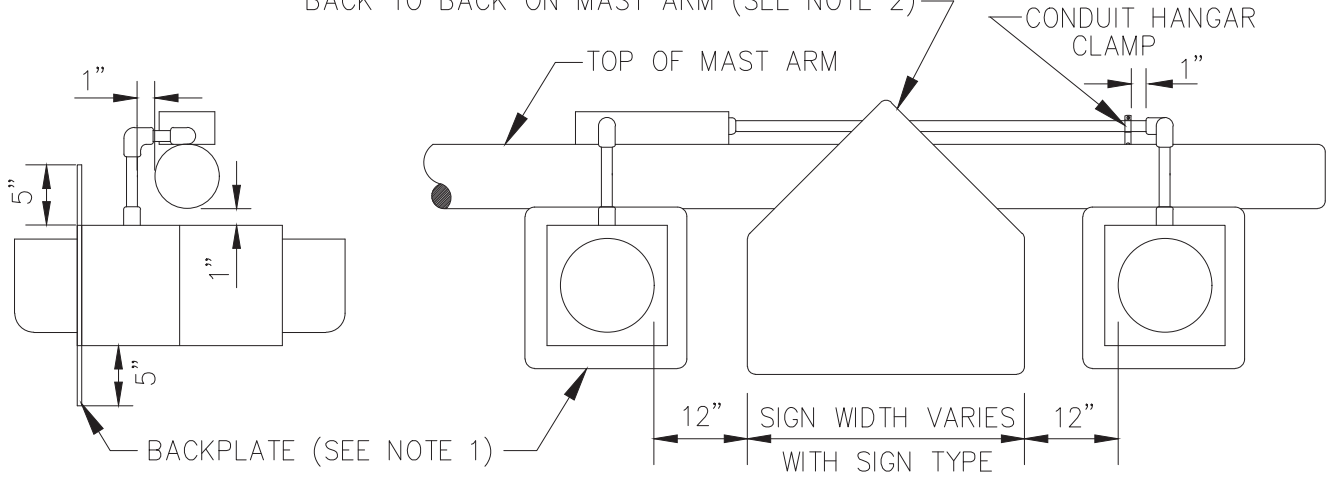
SPEED LIMIT SIGN BEACON

SECTION #
80.22

DETAIL #
80-57



TWO NON-ILLUMINATED SIGNS, MOUNTED BACK TO BACK ON MAST ARM (SEE NOTE 2)



SECTION AA

SECTION BB

NOTES:

1. PROVIDE ALL SIGNAL HEADS WITH 5" BACKPLATES.
2. CONTACT MOA SIGN SHOP FOR MOUNTING METHOD.
3. PROVIDE MINIMUM VERTICAL CLEARANCE OF 18' FROM ROADWAY TO BOTTOM OF SIGNAL HEAD HOUSING OR BOTTOM OF SIGN.
4. WIRE SIGNAL FACES 1 AND 2 ON FLASHER CIRCUIT 1 AND SIGNAL FACES 3 AND 4 ON FLASHER CIRCUIT 2.
5. EACH UNIT SHALL CONSIST OF FOUR 12-INCH AMBER L.E.D. SIGNAL FACES AND TUNNEL TYPE VISORS WITH OPEN SLOTS AT THE BOTTOM.

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OF ANCHORAGE

SCALE:
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MAST ARM MOUNTED SIGN BEACONS

SECTION #
80.22

DETAIL #
80-58

12-INCH YELLOW SIGNAL FACE WITH
YELLOW LENS AND TUNNEL TYPE VISOR
WITH OPEN SLOT AT THE BOTTOM

1-1/2" x VARIES NIPPLE

1.0'
MIN.

VARIES

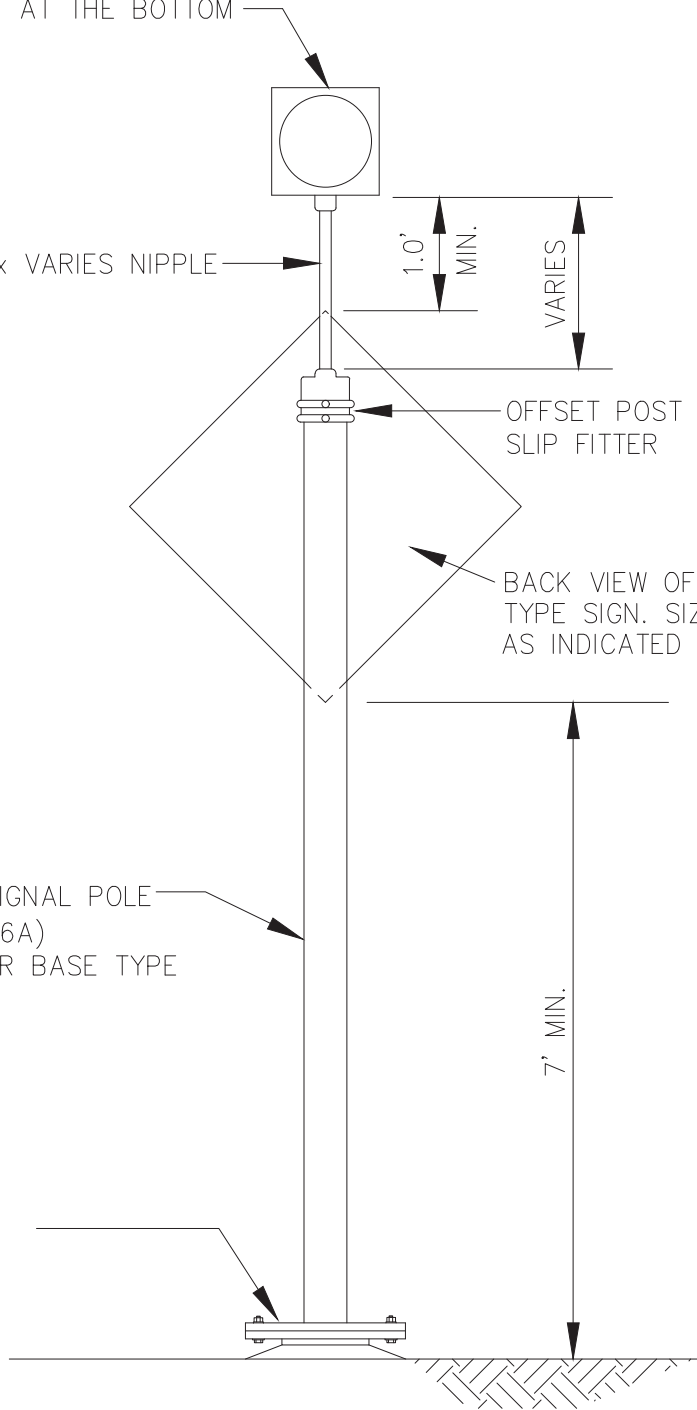
OFFSET POST TOP
SLIP FITTER

BACK VIEW OF A MUTCD
TYPE SIGN. SIZE AND TYPE
AS INDICATED ON DRAWINGS.

10' BREAKAWAY SIGNAL POLE
(SEE DETAIL 80-16A)
SEE DRAWINGS FOR BASE TYPE

7' MIN.

SEE DETAIL 80-12A
FOR FOUNDATION



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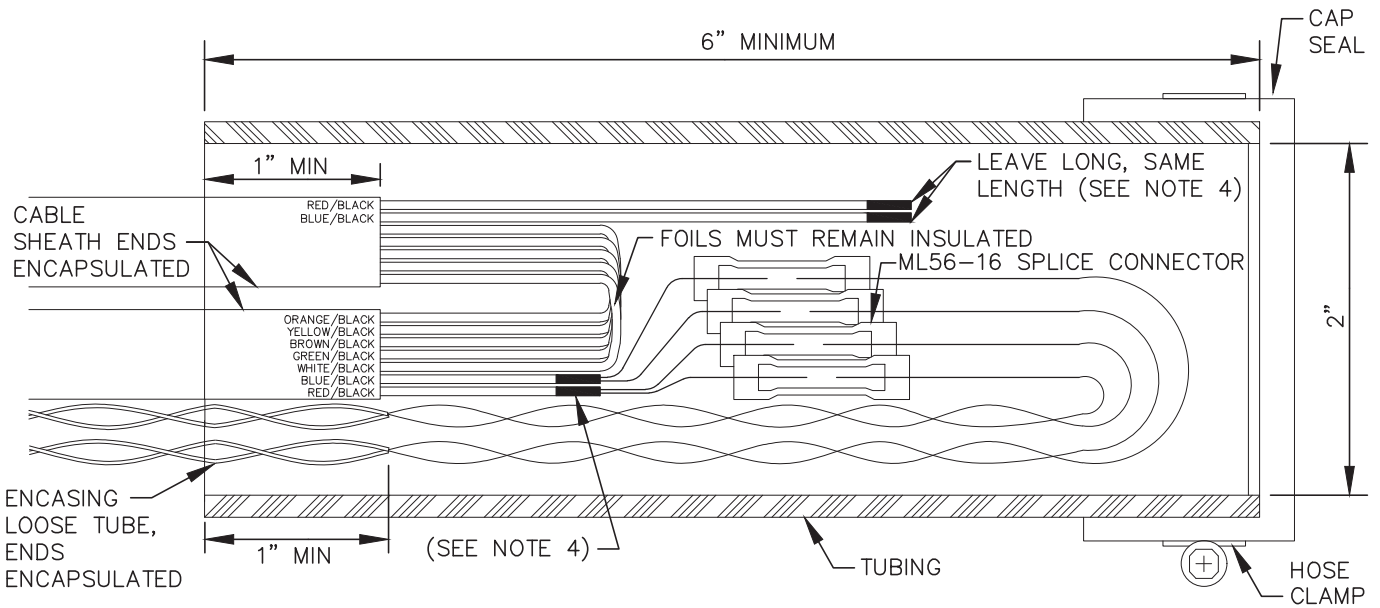
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WARNING SIGN BEACON

SECTION #
80.22

DETAIL #
80-59



MATERIAL PROPERTIES	
LOOP LEAD-IN SPLICE	
TUBING	2" HDPE FLEXIBLE CORRUGATED CONDUIT
CAP SEAL	FERNCO QWIK CAP #QC-102
HOSE CLAMP	STAINLESS STEEL
SPLICE CONNECTOR	MULTILINK ML56-16 OR APPROVED EQUAL
COMPOUND	RE-ENTERABLE ENCAPSULATION

NOTES:

1. FABRICATE LOOP LEAD-IN SPLICE IN THE FIELD AS SHOWN.
2. CAP SEAL ONE END AND COMPLETELY FILL OPEN END WITH RE-ENTERABLE ENCAPSULATION COMPOUND TO EDGE OF CORRUGATED CONDUIT.
3. LEAVE A MINIMUM OF 1/2" CLEARANCE BETWEEN THE ENCLOSURE AND THE SPLICE AT BOTH ENDS OF THE CORE FLOW.
4. EXPOSED FOIL AND DRAIN WIRES, SEAL WITH HEAT SHRINK TUBING (TYP).
5. SECURE CABLE/CONDUCTOR BUNDLE WITH NYLON CABLE TIES.

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MUNICIPALITY

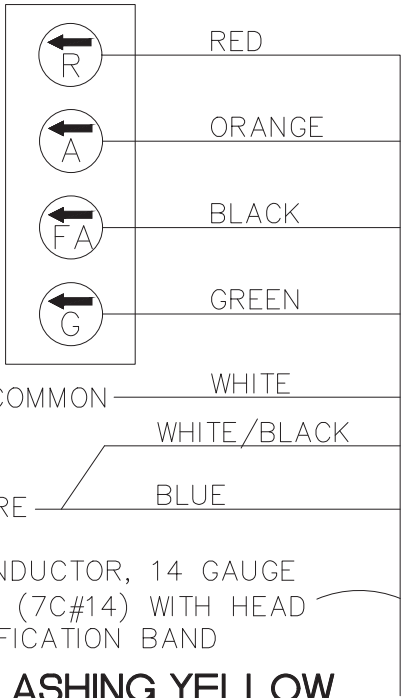
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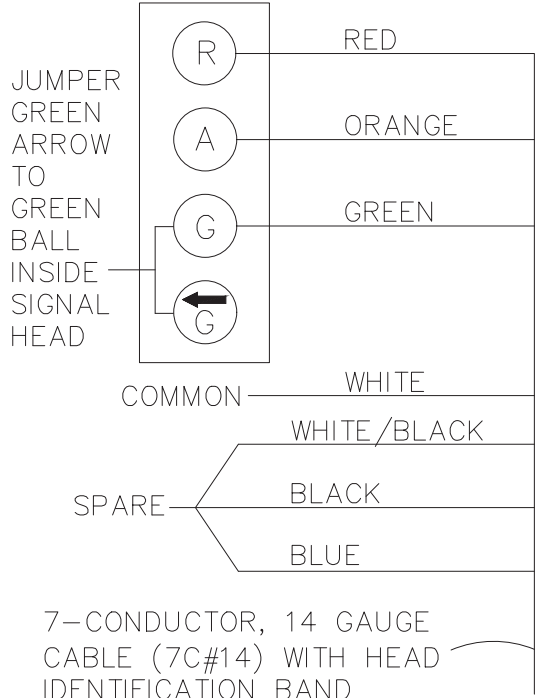
SPLICE DETAIL LOOP DETECTOR LEADS

SECTION #
80.48
 DETAIL #
80-60

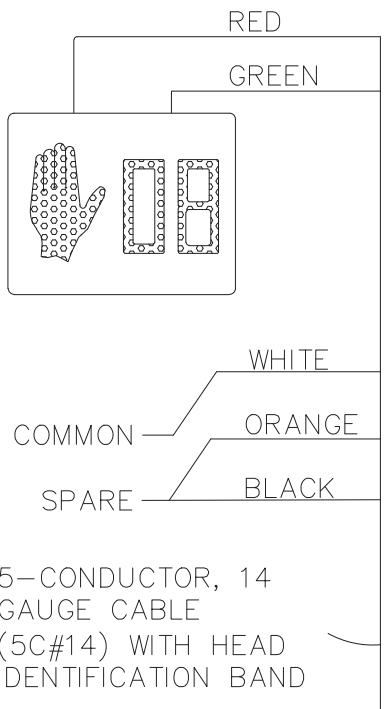
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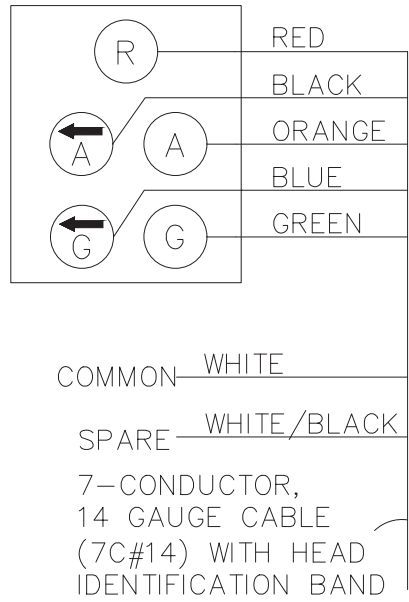
FLASHING YELLOW HEAD



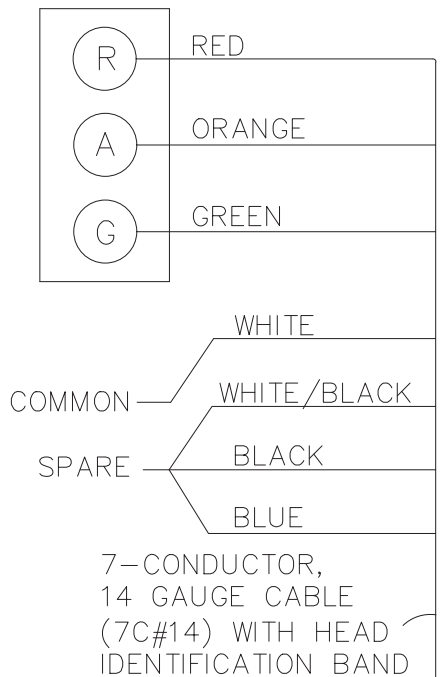
4 SECTION HEAD



PEDESTRIAN HEAD



5 SECTION HEAD



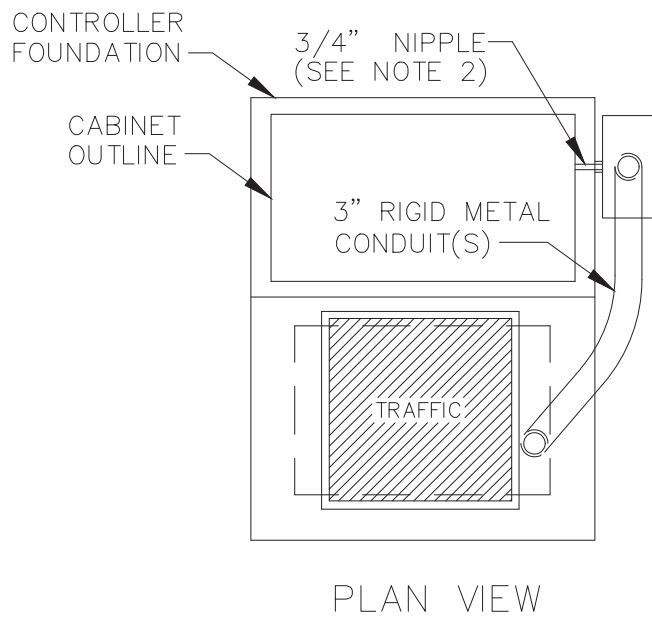
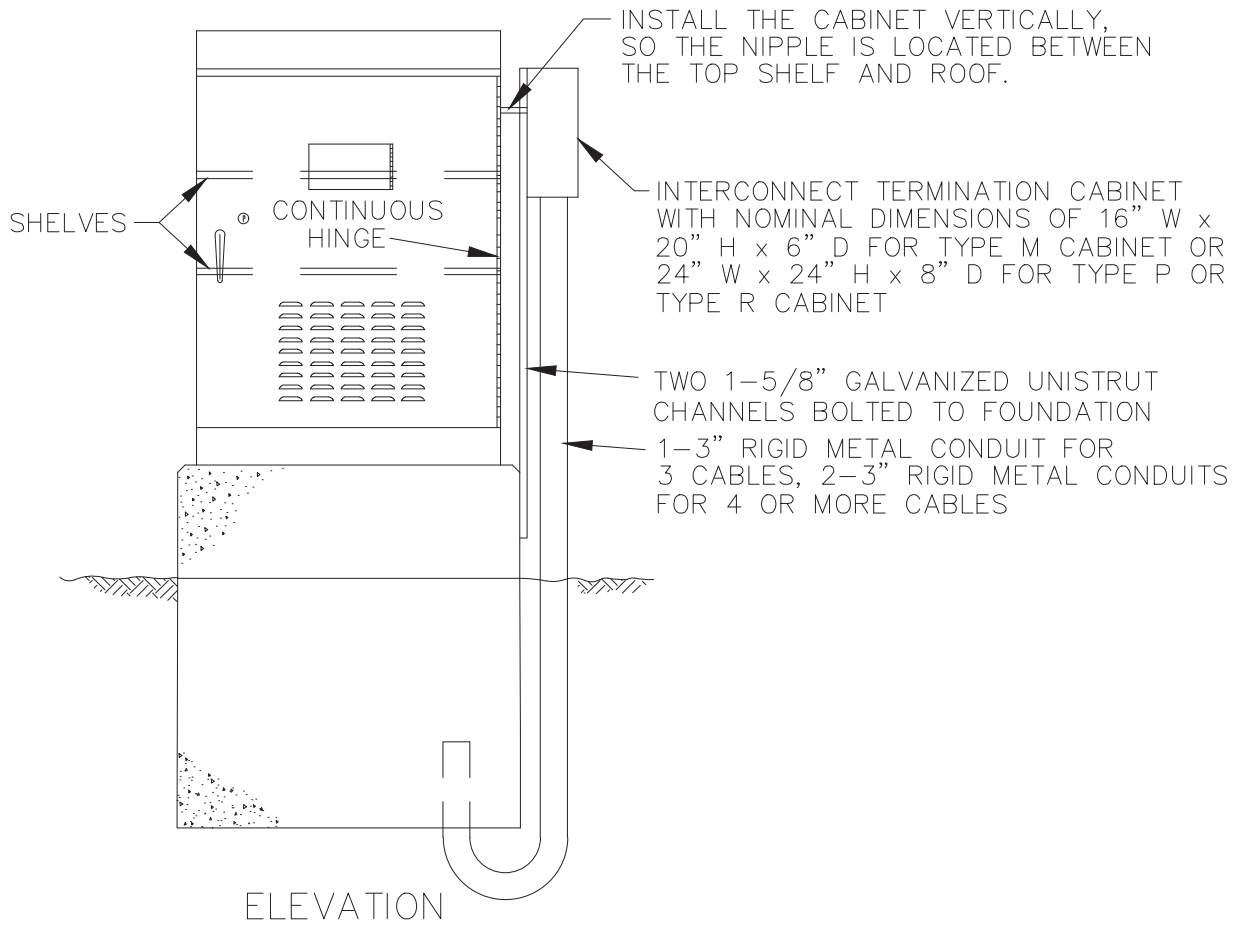
3 SECTION HEAD



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SIGNAL HEAD WIRING DETAILS

SECTION # 80.19 & 80.20
DETAIL # 80-61



NOTES:

1. INSTALL THE INTERCONNECT CABLE TERMINATION CABINET WHEN CALLED FOR IN THE DRAWINGS.
2. COORDINATE INSTALLATION LOCATION OF 3/4" NIPPLE WITH MOA TRAFFIC SIGNAL ELECTRONICS, PRIOR TO DRILLING HOLE IN CABINETS.
3. SEE DRAWINGS TO DETERMINE WHETHER TO INSTALL ON RIGHT OR LEFT SIDE WALL OF CONTROLLER CABINET.
4. DRILL HOLE IN STANDOFF MOUNTED BACK PANEL TO PROVIDE UNIMPEDED ACCESS TO NIPPLE FOR CABLE ROUTING. COORDINATE LOCATION WITH MOA TRAFFIC SIGNAL ELECTRONICS PRIOR TO DRILLING HOLE.

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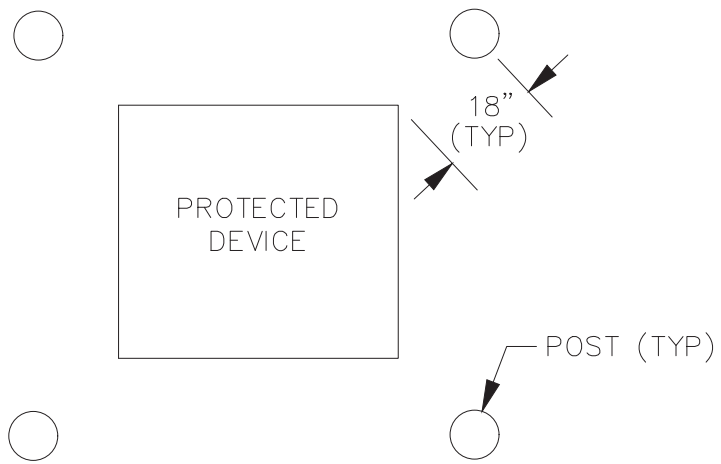
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INTERCONNECT CABLE TERMINATION CABINET

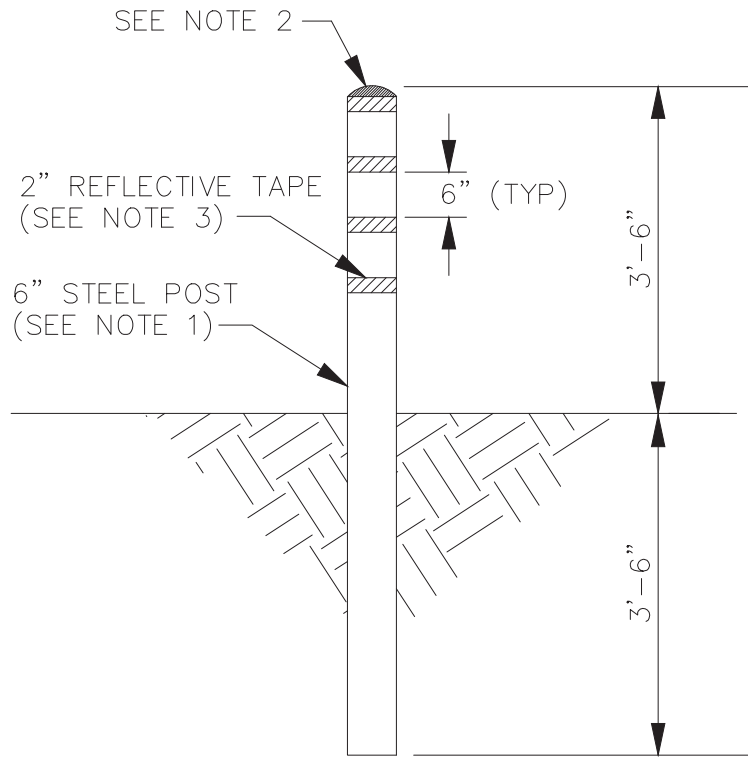
SECTION #
80.26

DETAIL #
80-62



PLAN

LOCATE POSTS AS SHOWN



POST DETAIL

NOTES:

1. PROVIDE 6" STEEL, SCHEDULE #40 PIPE, FILLED WITH CONCRETE.
2. ROUND CONCRETE AT TOP OF POST SMOOTH AND PAINT YELLOW.
3. INSTALL 4-2" BANDS OF YELLOW REFLECTIVE TAPE AS SHOWN.
4. LOCATION AND QUANTITY OF POSTS AS INDICATED ON DRAWINGS.

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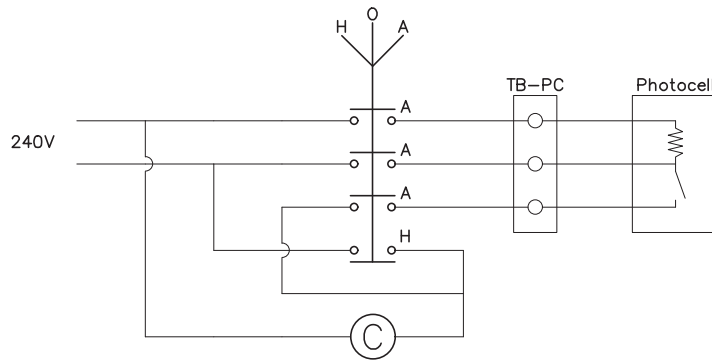
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**PROTECTIVE POST
ASSEMBLY**

SECTION #
80.27

DETAIL #
80-63



LIGHTING CONTACTOR CONTROL SCHEMATIC

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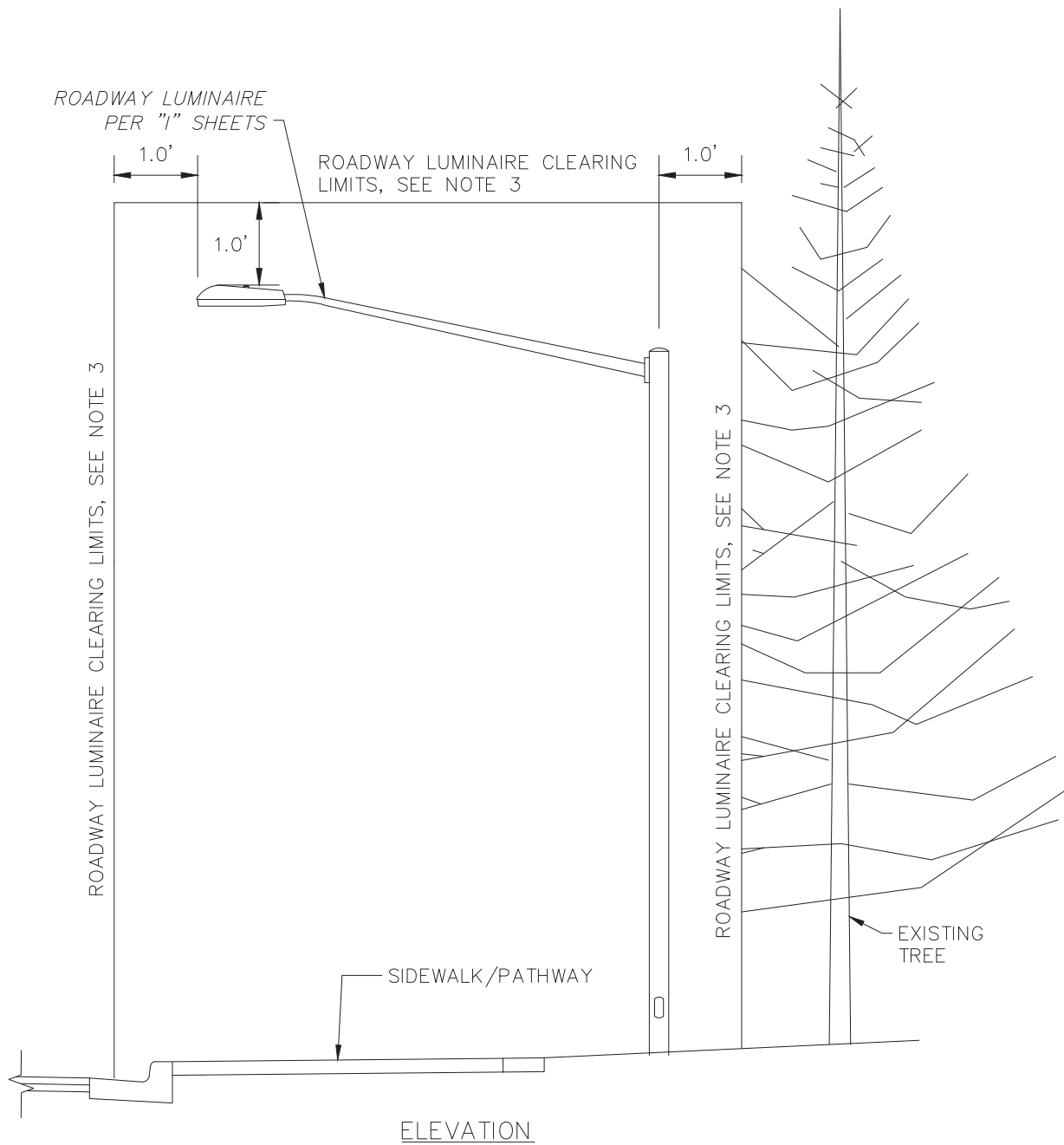
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ILLUMINATION CONTROL, PHOTOCELL

SECTION #
80.14

DETAIL #
80-64



NOTES:

1. ROADWAY LUMINAIRE CLEARING SHALL BE INCIDENTAL TO SECTION 20.04 CLEARING AND GRUBBING PAY ITEM AND NO SEPARATE PAYMENT SHALL BE MADE.
2. MAINTAIN CLEARING LIMITS WITHIN AVAILABLE RIGHT-OF-WAY OR TCP.
3. ROADWAY LUMINAIRE CLEARING LIMITS SHALL INCLUDE 20 FEET UP STATION AND DOWN STATION ALONG THE ROADWAY.
4. ALL CLEARING ACTIVITIES SHALL BE PERFORMED BY AN ISA CERTIFIED ARBORIST AND FOLLOW ANSI A300, PART 1, STANDARD PRACTICES AND ANSI Z133.1, ARBORICULTURAL OPERATIONS SAFETY.

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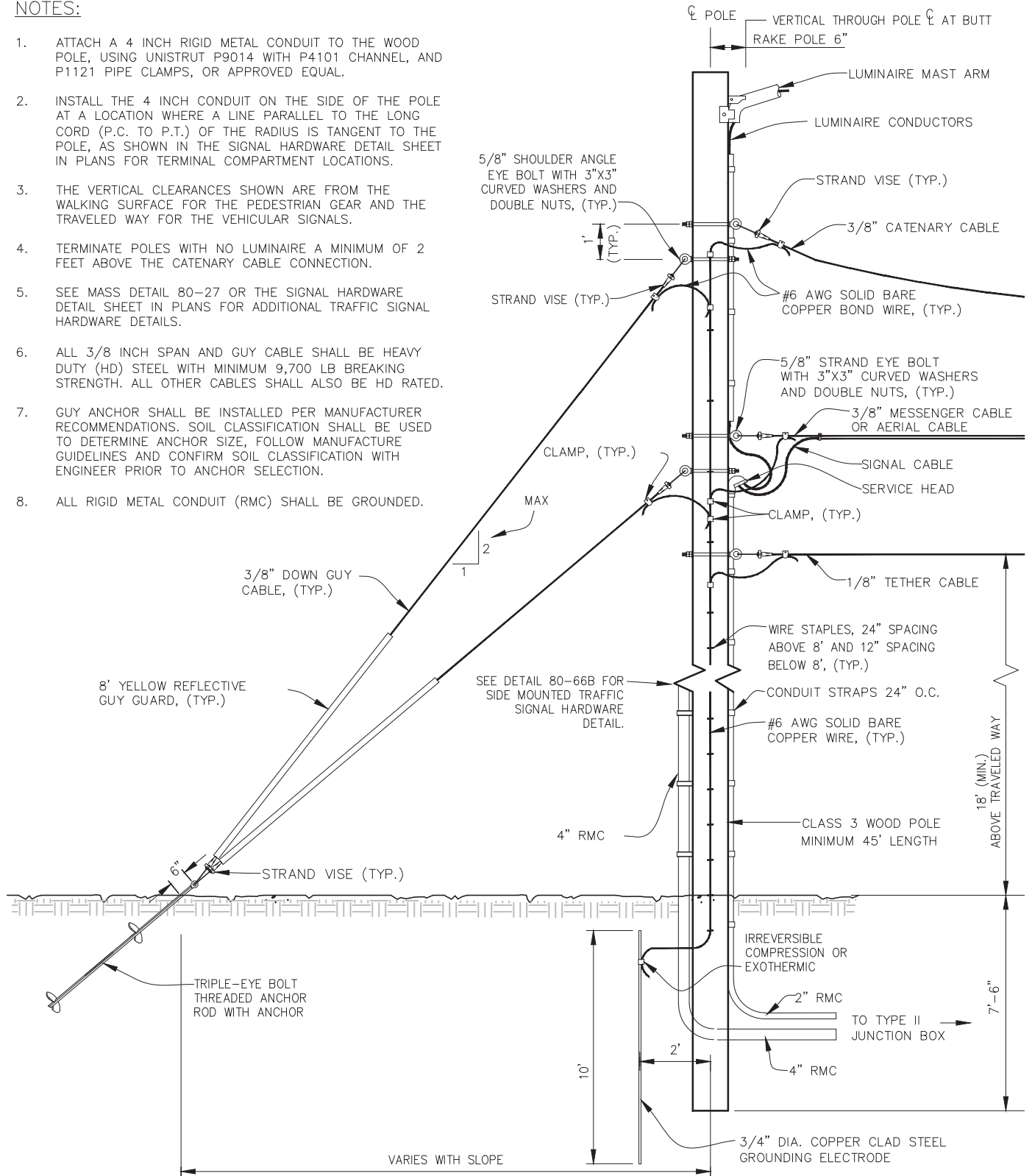
ROADWAY LUMINAIRE CLEARING DETAIL

SECTION #
N/A

DETAIL #
80-65

NOTES:

1. ATTACH A 4 INCH RIGID METAL CONDUIT TO THE WOOD POLE, USING UNISTRUT P9014 WITH P4101 CHANNEL, AND P1121 PIPE CLAMPS, OR APPROVED EQUAL.
2. INSTALL THE 4 INCH CONDUIT ON THE SIDE OF THE POLE AT A LOCATION WHERE A LINE PARALLEL TO THE LONG CORD (P.C. TO P.T.) OF THE RADIUS IS TANGENT TO THE POLE, AS SHOWN IN THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR TERMINAL COMPARTMENT LOCATIONS.
3. THE VERTICAL CLEARANCES SHOWN ARE FROM THE WALKING SURFACE FOR THE PEDESTRIAN GEAR AND THE TRAVELED WAY FOR THE VEHICULAR SIGNALS.
4. TERMINATE POLES WITH NO LUMINAIRE A MINIMUM OF 2 FEET ABOVE THE CATENARY CABLE CONNECTION.
5. SEE MASS DETAIL 80-27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR ADDITIONAL TRAFFIC SIGNAL HARDWARE DETAILS.
6. ALL 3/8 INCH SPAN AND GUY CABLE SHALL BE HEAVY DUTY (HD) STEEL WITH MINIMUM 9,700 LB BREAKING STRENGTH. ALL OTHER CABLES SHALL ALSO BE HD RATED.
7. GUY ANCHOR SHALL BE INSTALLED PER MANUFACTURER RECOMMENDATIONS. SOIL CLASSIFICATION SHALL BE USED TO DETERMINE ANCHOR SIZE, FOLLOW MANUFACTURE GUIDELINES AND CONFIRM SOIL CLASSIFICATION WITH ENGINEER PRIOR TO ANCHOR SELECTION.
8. ALL RIGID METAL CONDUIT (RMC) SHALL BE GROUNDED.



WOOD TRAFFIC POLE DETAIL
 NTS
 (SINGLE SPAN ATTACHMENT SHOWN)

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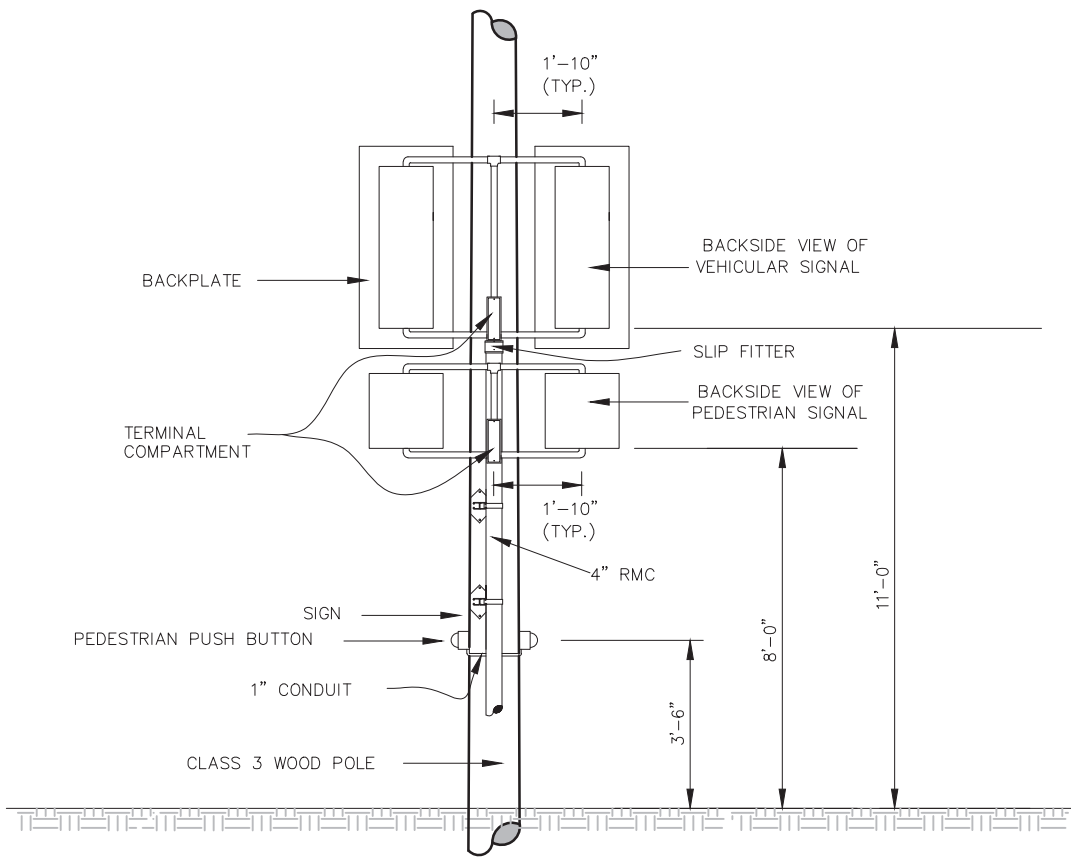
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**TEMPORARY WOOD SIGNAL
 POLE DETAILS
 (UNDERGROUND SERVICE)**

SECTION #
 80.19
 DETAIL #
 80-66A

NOTES:

1. ATTACH A 4 INCH RIGID METAL CONDUIT TO THE WOOD POLE, USING UNISTRUT P9014 WITH P4101 CHANNEL, AND P1121 PIPE CLAMPS, OR APPROVED EQUAL.
2. INSTALL THE 4 INCH CONDUIT ON THE SIDE OF THE POLE AT A LOCATION WHERE A LINE PARALLEL TO THE LONG CORD (P.C. TO P.T.) OF THE RADIUS IS TANGENT TO THE POLE, AS SHOWN IN THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR TERMINAL COMPARTMENT LOCATIONS.
3. USE POST TOP SIGNAL FRAMES WITH TERMINAL COMPARTMENTS TO INSTALL THE VEHICULAR SIGNAL HEADS ON TOP OF THE 4 INCH CONDUIT.
4. USE SIDE MOUNTED SIGNAL FRAMES WITH TERMINAL COMPARTMENTS TO INSTALL THE PEDESTRIAN SIGNAL HEADS ON THE 4 INCH CONDUIT.
5. THE VERTICAL CLEARANCES SHOWN ARE FROM THE WALKING SURFACE FOR THE PEDESTRIAN GEAR AND THE TRAVELED WAY FOR THE VEHICULAR SIGNALS.
6. SEE MASS DETAIL 80-27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR ADDITIONAL TRAFFIC SIGNAL HARDWARE DETAILS.
7. ALL RIGID METAL CONDUIT (RMC) SHALL BE GROUNDED.



SIDE MOUNTED TRAFFIC SIGNAL HARDWARE

NTS

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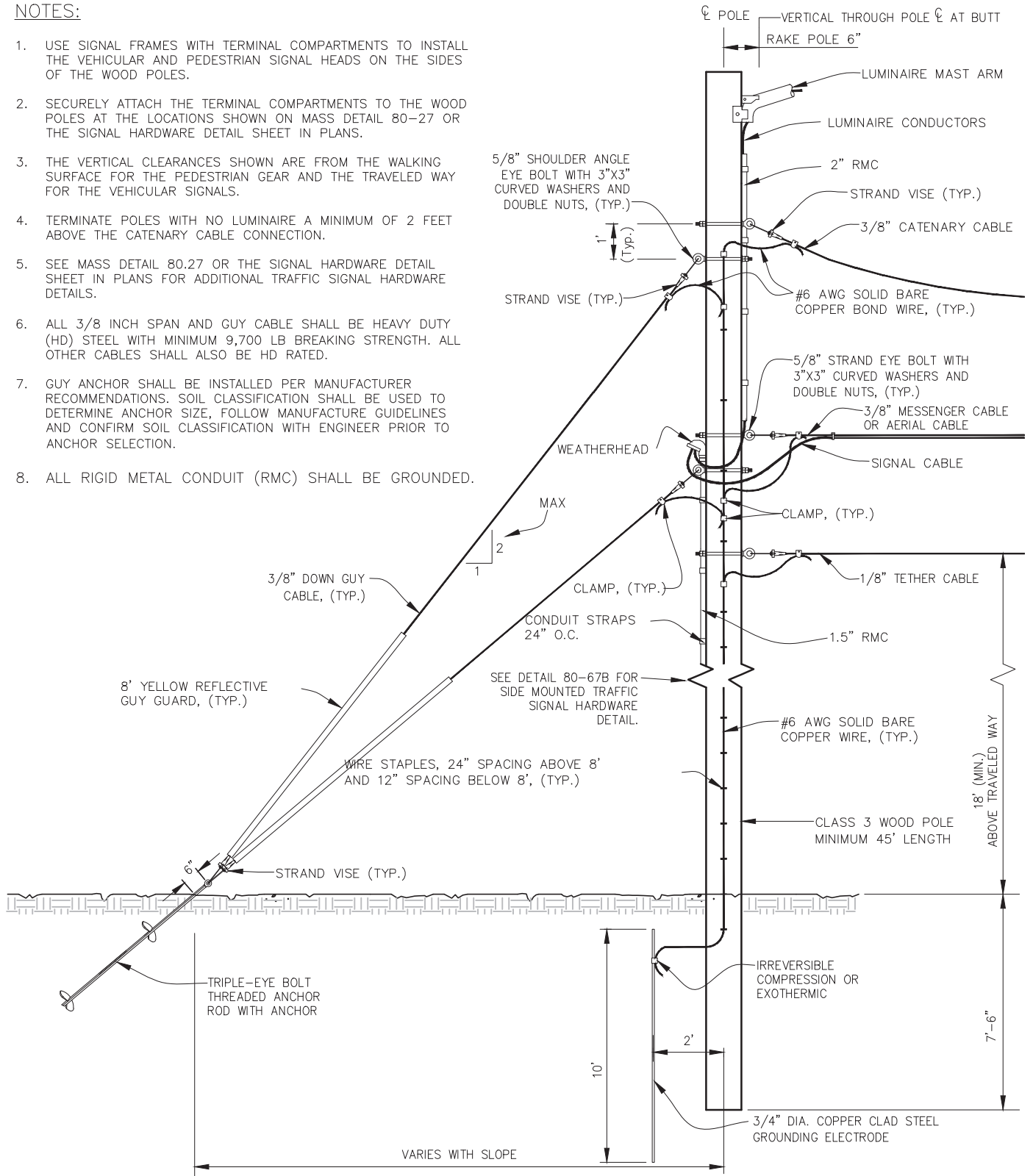
TEMPORARY SIDE MOUNTED TRAFFIC SIGNAL HARDWARE (UNDERGROUND SERVICE)

SECTION #
80.19

DETAIL #
80-66B

NOTES:

1. USE SIGNAL FRAMES WITH TERMINAL COMPARTMENTS TO INSTALL THE VEHICULAR AND PEDESTRIAN SIGNAL HEADS ON THE SIDES OF THE WOOD POLES.
2. SECURELY ATTACH THE TERMINAL COMPARTMENTS TO THE WOOD POLES AT THE LOCATIONS SHOWN ON MASS DETAIL 80-27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS.
3. THE VERTICAL CLEARANCES SHOWN ARE FROM THE WALKING SURFACE FOR THE PEDESTRIAN GEAR AND THE TRAVELED WAY FOR THE VEHICULAR SIGNALS.
4. TERMINATE POLES WITH NO LUMINAIRE A MINIMUM OF 2 FEET ABOVE THE CATENARY CABLE CONNECTION.
5. SEE MASS DETAIL 80.27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR ADDITIONAL TRAFFIC SIGNAL HARDWARE DETAILS.
6. ALL 3/8 INCH SPAN AND GUY CABLE SHALL BE HEAVY DUTY (HD) STEEL WITH MINIMUM 9,700 LB BREAKING STRENGTH. ALL OTHER CABLES SHALL ALSO BE HD RATED.
7. GUY ANCHOR SHALL BE INSTALLED PER MANUFACTURER RECOMMENDATIONS. SOIL CLASSIFICATION SHALL BE USED TO DETERMINE ANCHOR SIZE, FOLLOW MANUFACTURE GUIDELINES AND CONFIRM SOIL CLASSIFICATION WITH ENGINEER PRIOR TO ANCHOR SELECTION.
8. ALL RIGID METAL CONDUIT (RMC) SHALL BE GROUNDED.



WOOD TRAFFIC POLE DETAIL
 NTS
 (SINGLE SPAN ATTACHMENT SHOWN)

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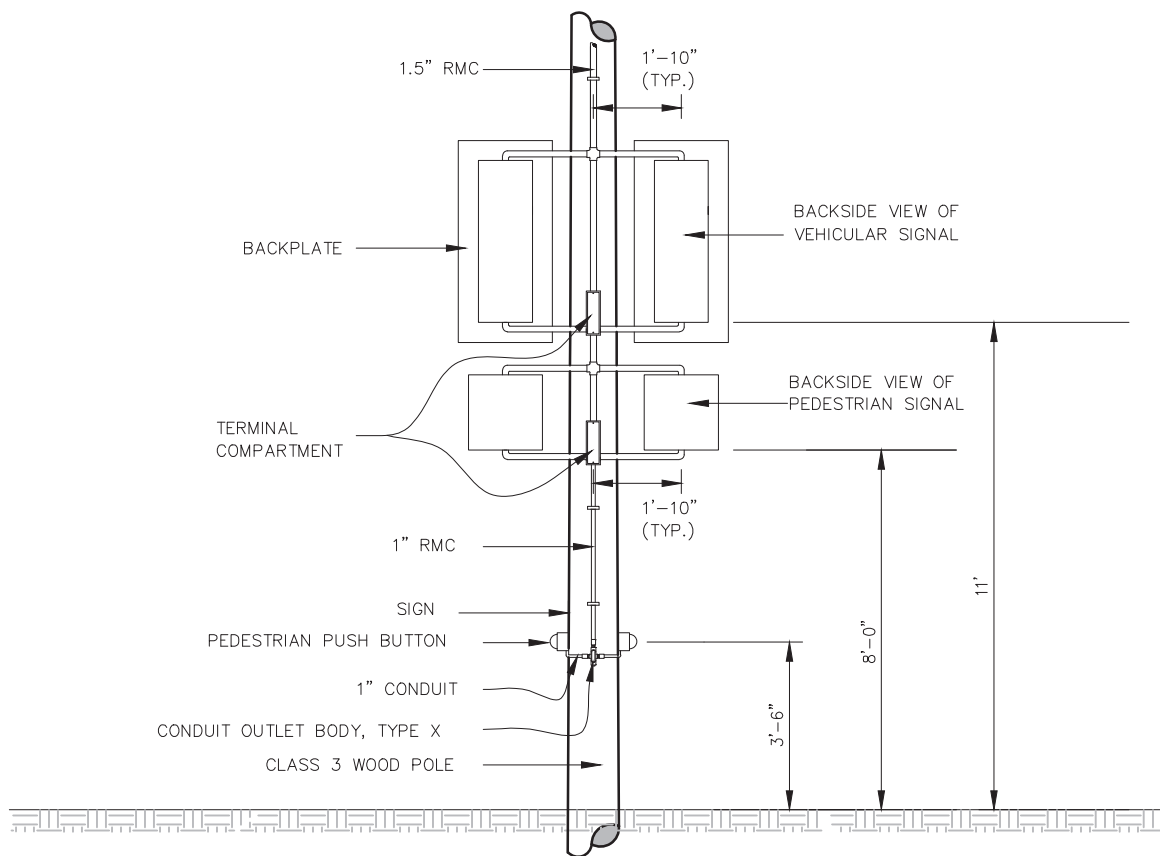
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TEMPORARY WOOD SIGNAL POLE DETAILS (OVERHEAD SERVICE)

SECTION #
 80.19
 DETAIL #
 80-67A

NOTES:

1. USE SIGNAL FRAMES WITH TERMINAL COMPARTMENTS TO INSTALL THE VEHICULAR AND PEDESTRIAN SIGNAL HEADS ON THE SIDES OF THE WOOD POLES.
2. SECURELY ATTACH THE TERMINAL COMPARTMENTS TO THE WOOD POLES AT THE LOCATIONS SHOWN ON MASS DETAIL 80-27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS.
3. THE VERTICAL CLEARANCES SHOWN ARE FROM THE WALKING SURFACE FOR THE PEDESTRIAN GEAR AND THE TRAVELED WAY FOR THE VEHICULAR SIGNALS.
4. SEE MASS DETAIL 80.27 OR THE SIGNAL HARDWARE DETAIL SHEET IN PLANS FOR ADDITIONAL TRAFFIC SIGNAL HARDWARE DETAILS.
5. ALL RIGID METAL CONDUIT (RMC) SHALL BE GROUNDED.



SIDE MOUNTED TRAFFIC SIGNAL HARDWARE
NTS

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

 OF ANCHORAGE

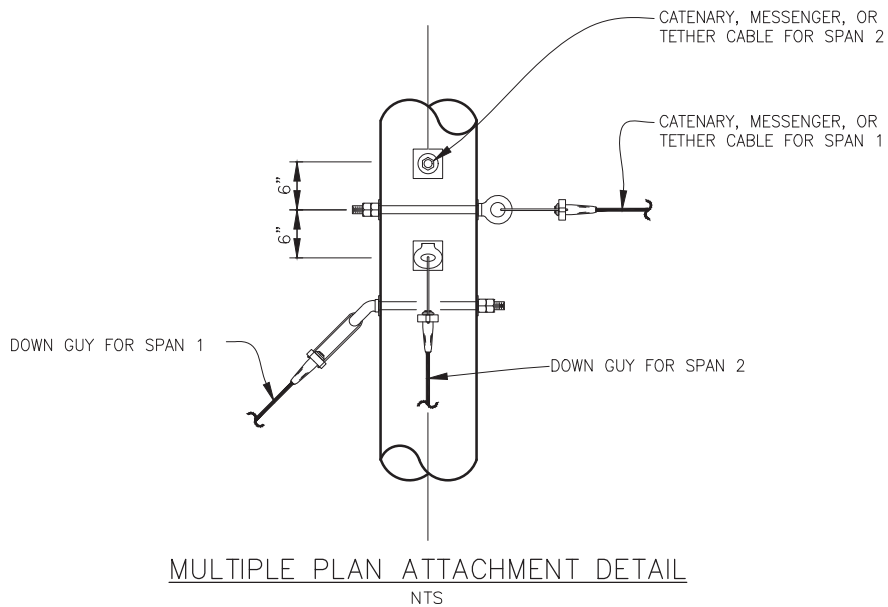
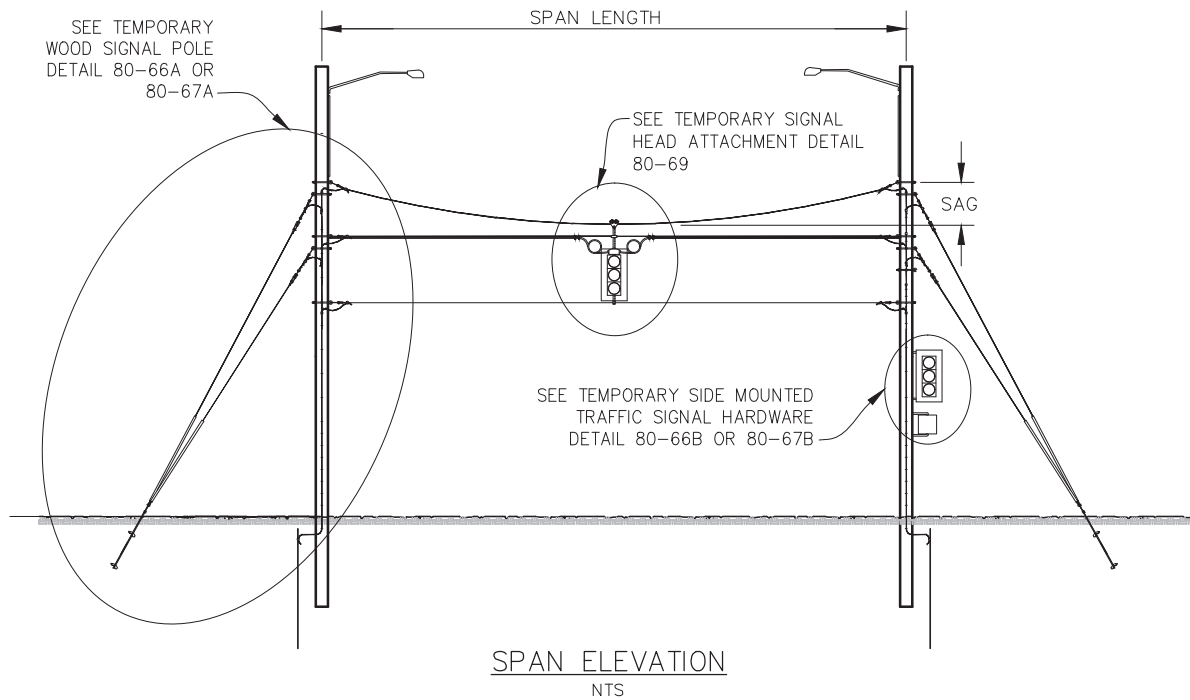
SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

**TEMPORARY SIDE MOUNTED
 TRAFFIC SIGNAL HARDWARE
 (OVERHEAD SERVICE)**

SECTION #
80.19
 DETAIL #
80-67B

NOTES:

1. SAG=4% TO 5% OF SPAN LENGTH.



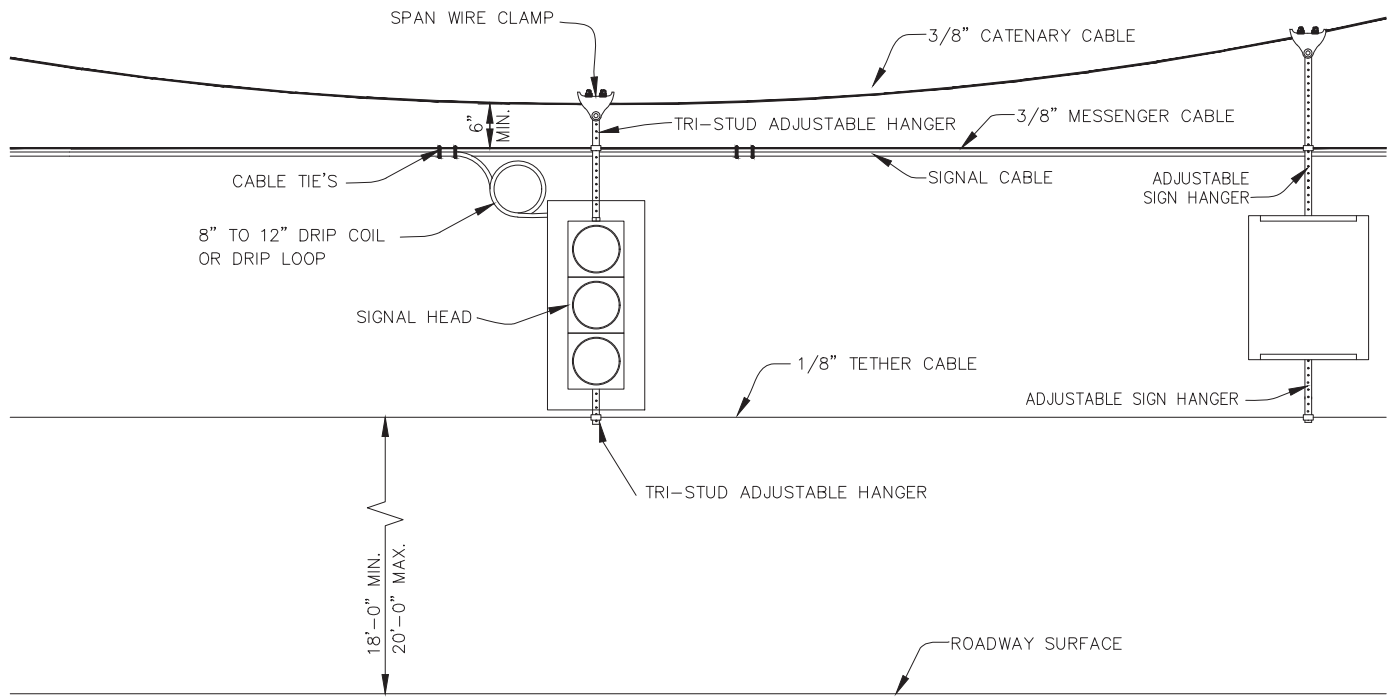
REVISION: 2024 M.A.S.S. UPDATE



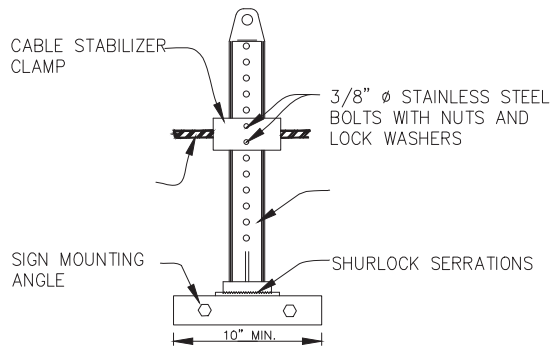
SCALE:
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APPROVED:
REVISED:
2/24

**TEMPORARY TRAFFIC SIGNAL
SPAN WIRE DETAILS**

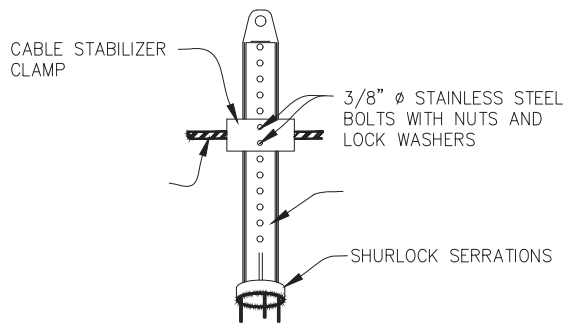
SECTION #
80.19
DETAIL #
80-68



SIGNAL HEAD AND SIGN ATTACHMENT DETAIL
NTS



ADJUSTABLE HANGER FOR SIGN MOUNTING
NTS



TRI-STUD ADJUSTABLE HANGER
NTS

NOTES:

1. ATTACH ADJUSTABLE HANGERS TO THE MESSENGER AND TETHER CABLES WITH CABLE STABILIZER CLAMPS.
2. ATTACH SIGNAL CABLES TO MESSENGER CABLE EVERY 1' USING 3M HEAVY DUTY BLACK CABLE TIES OR APPROVED EQUAL. CABLE TIES SHALL BE WEATHER RESISTANT BLACK NYLON GREATER THAN 0.065" THICK, HAVE A TENSILE STRENGTH GREATER THAN 110LBS, AND HAVE A TEMPERATURE RANGE BETTER THAN -35°F TO 180°F. USE TWO TIES BEFORE/AFTER DRIP LOOPS. CABLE TIES SHALL BE ATTACHED "SNUG TIGHT", DO NOT OVER TIGHTEN.
3. INSTALL SIGNS SO THAT THE BOTTOM EDGES ARE AT APPROXIMATELY THE SAME ELEVATION.
4. SAG=4% TO 5% OF SPAN LENGTH.

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

OF ANCHORAGE

SCALE:
N.T.S.

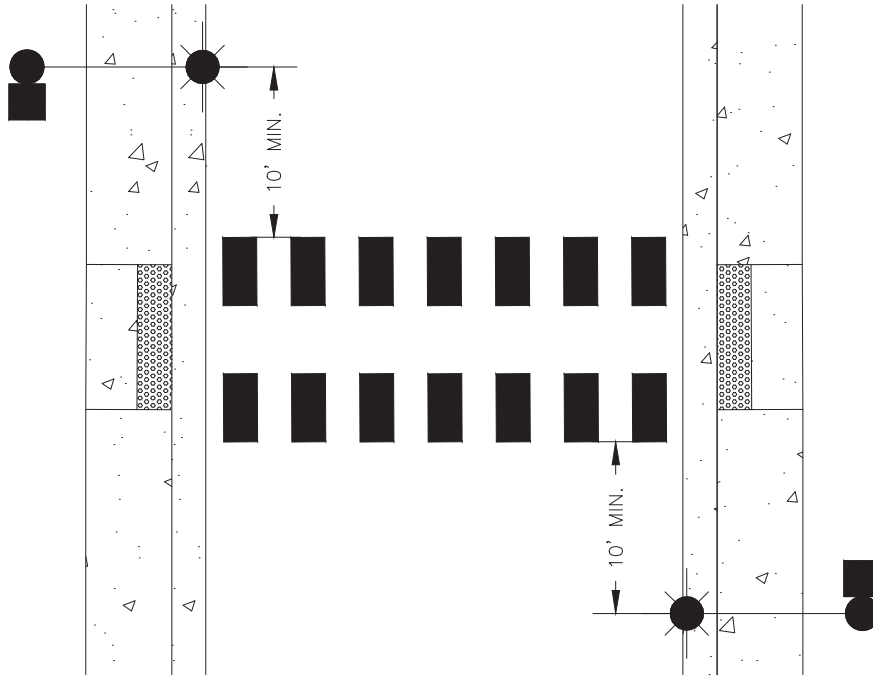
APPROVED:

REVISED:
2/24

TEMPORARY SIGNAL HEAD ATTACHMENT DETAILS

SECTION #
80.19

DETAIL #
80-69



MIDBLOCK CROSSWALK LUMINAIRE LAYOUT
NTS

RECOMMENDED MIDBLOCK CROSSWALK VERTICAL ILLUMINANCE	
PEDESTRIAN CONFLICT AREA	AVERAGE VERTICAL ILLUMINANCE (FC)*
HIGH	3.7
MEDIUM	2.8
LOW	1.9

*PER ANSI/IES RP-8-22

NOTES:

1. PLACE LUMINAIRES IN ADVANCE OF THE CROSSWALK ON EACH SIDE OF THE ROAD TO PROVIDE POSITIVE CONTRAST LIGHTING TO ONCOMING TRAFFIC AS SHOWN ABOVE.
2. SELECT LUMEN OUTPUT, DISTRIBUTION AND THE LOCATIONS OF THE LUMINAIRES ON EITHER SIDE OF THE CROSSWALK TO MEET MINIMUM AVERAGE VERTICAL ILLUMINANCE SHOWN IN THE TABLE ABOVE.
3. ILLUMINATE THE ROADWAY AND PEDESTRIAN FACILITIES ON EITHER SIDE OF THE CROSSWALK PER THE REQUIREMENTS OF CHAPTER 5 OF THE PM&E DESIGN CRITERIA MANUAL.

REVISION: 2024 M.A.S.S. UPDATE

MUNICIPALITY

 OF ANCHORAGE

SCALE:
N.T.S.
 APPROVED:
 REVISED:
2/24

**MIDBLOCK CROSSWALK
LUMINAIRE LAYOUT**

SECTION #
80.23
 DETAIL #
80-70

