Purchasing Division
Finance Department

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Addendum No. 2
Solicitation 25-99717
Railroad Street Reconditioning

This addendum serves to notify all bidders of the following changes to the solicitation documents:

INFORMATION TO BIDDERS:

1. Full depth reclamation depth is expected to be 10" total depth including existing bituminous pavement and aggregate base. The thickness of each layer of material (aggregate base and bituminous pavement) may vary within the section depending on the location along the corridor.
2. Excess reclaim material shall be removed from the work area and disposed of in accordance with applicable local, state, and federal regulations.
3. Removal of excess reclaim material shall be included/incidental in the bid price for "Full Depth Reclamation".
4. Contractors will need to provide additional detail and traffic control for work within intersections.
5. Work within intersections shall be performed in "off-hours", defined as hours outside of typical morning and afternoon commutes. These are generally assumed to be 7 to 9:00 am and 3:00 to 6:00 pm. Limited work may be allowed overnight with permission of the engineer. Work within intersections cannot occur during weekends. These restrictions specifically do not apply to traffic control or erosion control maintenance, which are allowed.
6. Contractors can propose changes to the presented traffic control layouts and project phasing based on their preferred work schedule and style as noted in S-29.1A. The City retains the right to review and approve any proposed alterations.
7. Replacement of pavement where bricks were present should be per plan:
    a. Concrete on sidewalks
    b. Bituminous pavement on streets.
8. Temporary pavement is bituminous pavement placed where the median must be removed to allow two lanes of traffic to move. It is intended to be a single 2" lift of wear course pavement, which would be removed as the median is replaced. Full placement and removal of temporary pavement should be included in the pay item.

CHANGES TO DRAWINGS:

1. **Sheet 59 (Temporary Signal System "B", Pole and Cabinet Notes, Railroad St at South Lake Avenue/Lake Place Drive)**, revise the following pole notes:

    - Wood Pole 2: Revise the 3rd line from "1-Type 10B-Wood Pole Mounted 0 Deg (2-4, P6-1)" to the following:

        1-Special Mount Signal (Cluster Head) With Extension (to allow for turning of head)-Wood Pole Mounted 90 Deg (2-4)

1-Set C.D. Pedestrian Indications and Bracketing-Wood Pole Mounted 90 Deg (P6-1)

- Temporary Signal Standard 5 – revise the 4th line from "12' (MIN) Pedestal Pole and Post Collar" to the following:

  14' (MIN) Pedestal Pole and Post Collar

- Temporary Signal Standard 5 – revise the 5th line from "1-Type 2C-Pole Mounted (6-4, 8-1, P2-1, P8-2)" to the following:

  1-Special Mount Signal (Cluster Head) and Bracketing-Pole Mounted (6-4, Facing Eastbound Traffic)

  1-Angle Mount Signal and Bracketing-Pole Mounted (8-1, Facing Northbound Traffic)

  2-Sets C.D. Pedestrian Indications and Bracketing-Pole Mounted (Angle Mount) (P2-1, P8-2)

2. **Sheet 44 (Traffic Signal Systems A-B, Equipment Pad Layouts)**, revise each layout on the plans to revise from "Install Signal Controller Cabinet (Furnished by City)" to instead read "Signal Controller Cabinet to be F & I by Contractor".
3. **Sheet 62 (Traffic Signal System A, Pole and Cabinet Notes) and Sheet 66 (Traffic Signal System B, Pole and Cabinet Notes)**, revise the A note listing from "Install Controller and Cabinet (Furnished by City)" to instead read "Controller and Cabinet (to be F & I by Contractor)".
4. **Sheet 62 (Traffic Signal System A, Pole and Cabinet Notes) and Sheet 66 (Traffic Signal System B, Pole and Cabinet Notes)**, revise the pole notes for all new traffic signal mast arms and poles, so that the mast arms and poles (for poles 1, 2, 3, and 4) are all called out to be CONTRACTOR furnished and installed (instead of City furnished).
5. All items of each permanent signal system A and B are to be Contractor furnished and installed (the City of Duluth is NOT providing any materials for either permanent signal system to the Contractor).

CHANGES TO SPECIAL PROVISIONS

1. Delete entire Division SS specification section included in the bid package, and substitute the attached REVISED DIVISION SS specification section instead. Changes to the REVISED Division SS specification section are denoted in red.

CHANGES TO BID ITEMS:

The middle lift of pavement in the typical sections shall be modified to be wearing course mixture. Updates estimated quantities are

- SPEC NUMBER 2360.509 TYPE SP 9.5 WEARING COURSE MIXTURE (4,C): 1773 TONS HAS BEEN UPDATED TO **TYPE SP 9.5 WEARING COURSE MIXTURE (4C): 3532 TONS**
- SPEC NUMBER 2360.509 TYPE SP 12.5 WEARING COURSE MIXTURE (4,C): 3477 TONS HAS BEEN UPDATED TO **TYPE SP 9.5 NON WEARING COURSE MIXTURE (4C): 1766 TONS**

Please acknowledge receipt of this Addendum by checking the acknowledgement box within the www.bidexpress.com solicitation.

Posted: **October 2, 2025**

DIVISION SS

I hereby certify that the Special Provisions for traffic control signal construction (Division SS) contained in this proposal were prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

_____

John M. Gray, PE

Lic. No. 22457 Date: October 1, 2025

Table of Contents

SS-1 (2104) REMOVING TRAFFIC CONTROL SIGNAL SYSTEMS

SS-1.1 DESCRIPTION

This Work consists of backfilling trenches, holes, depressions, and removing and salvaging, or disposing of miscellaneous structures, equipment, and materials as shown on the Plans, from two (2) existing traffic control signal systems as follows:

SYSTEM "A" - at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue in the City of Duluth, St. Louis, County, and

SYSTEM "B" - at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive in the City of Duluth, St. Louis County.

SS-1.2 MATERIALS

Use materials in accordance with MnDOT 2104, “Removing Miscellaneous Structures” and these Special Provisions.

SS-1.3 CONSTRUCITON REQUIREMENTS

A Salvage Traffic Control Signal Cabinet and Equipment

To ensure proper care and prevent damage during removal, handling and shipping of control signal cabinets and equipment, provide in order the following:

(1) De-energize the traffic control cabinet and equipment
(2) Disconnect the power conductors
(3) Unplug and remove removable control equipment including the controller unit, detector amplifier units, conflict monitor, and load switches from the cabinet
(4) Package and secure the removed control equipment in a method and manner that prevents damage to the equipment during handling and shipping
(5) Coil together the connecting harnesses of the removed equipment
(6) Fasten and secure the harnesses to a cabinet shelf in a method and manner that prevents the harnesses from being damaged when closing the cabinet door and from falling through the bottom of the cabinet during removal, handling, and shipping
(7) Secure the cabinet in an upright position when removing, handling, and shipping
(8) Return the salvaged traffic control signal cabinet to the City’s signal shop (1532 West Michigan Street, Duluth, MN 55806).
(9) Ensure the City issues a comprehensive receipt for items salvaged.

B Salvage Non-Intrusive Detection Equipment

To ensure proper care and prevent damage during removal, handling, and shipping of Non-Intrusive detection equipment (video vehicle detection cameras and pole mounted extensions/hardware, and all internal cabinet equipment), provide in order the following:

(1) De-energize the equipment
(2) Remove the power and interface conductors
(3) Package the equipment to prevent damage during delivery to the City
(4) Return the salvaged equipment to the City’s signal shop (1532 West Michigan Street, Duluth, MN 55806)
(5) Ensure the City issues a comprehensive receipt for items salvaged.

C Removal Operations

Remove in place Materials as specified on the Plans.

Except under non-impacted surfaces, remove in-place conduit systems, cables and conductors.

Do not Abandon the in-place conduit systems, cables, and conductors unless it has been determined by the Engineer that removal operations would have a direct negative impact on a structure, facility, or vegetation listed in MnDOT 2572.3A “Protecting and Preserving”.

Backfill trenches, holes, and depressions caused by removal operations in accordance with MnDOT 2104.3E “Backfilling Depressions”.

Destroy removed structures not containing lead by rendering them unusable to the satisfaction of the Engineer before disposing.

Dispose of Materials in accordance with MnDOT 2104.3D “Disposal of Materials and Debris”.

Submit to the Engineer a receipt from the facility where Materials were delivered and disposed of or recycled.

C.1 Materials with Lead Based Paint

Handle, transport, and dispose of lead-based painted Materials as follows:

(1) Read, certify understanding, and agree to abide to the requirements in OSHA 29 CFR 1926.62 and Minnesota Rules Chapter 5206, 7025, 7035, 7045 relating to the removal and disposal of lead based painted Materials as regulated waste at a MnDOT approved waste contractor. See regulated waste contractors list at: http://www.dot.state.mn.us/environment/regulatedmaterials/wastemgmt.html

(2) Handle, transport, and dispose of Materials with peeling or flaking lead-based paint as hazardous waste in accordance with Occupational Safety & Health Administration (OSHA) and the Minnesota Pollution Control Agency (MPCA) regulations. Peeling or flaking lead based paint chips are required to be collected onsite and disposed of by a City approved hazardous waste contractor.

(3) Submit to the Engineer a completed “Transfer of Ownership” found at: http://www.dot.state.mn.us/environment/regulatedmaterials/ownership.html

(4) Follow the links below to obtain the current work order form and the list of approved waste contractors.

http://www.dot.state.mn.us/environment/regulatedmaterials/wastemgmt.html

Hazardous Waste Work ***Order Form (Word)***

MnDOT approved list of waste contractors (Word)

SS-1.4 METHOD OF MEASUREMENT

A Removing Traffic Control Signal System

Removing and salvaging, or disposing of miscellaneous structures, equipment, and materials from the existing traffic control signal systems:

SYSTEM "A" - at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue in the City of Duluth, St. Louis, County, and

SYSTEM "B" - at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive in the City of Duluth, St. Louis County.

and backfilling trenches, holes, and depressions will be measured as an integral unit.

SS-1.5 BASIS OF PAYMENT

A Traffic Control Signal System

Removing and salvaging, or disposing of miscellaneous structures, equipment, and materials from the existing traffic control signal systems:

SYSTEM "A" - at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue in the City of Duluth, St. Louis, County, and

SYSTEM "B" - at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive in the City of Duluth, St. Louis County.

and backfilling trenches, holes, and depressions will be paid for separately as specified for Item No. 2104.502 (REMOVE SIGNAL SYSTEM A) and Item No. 2104.502 (REMOVE SIGNAL SYSTEM B).

B Haul Salvaged Material

Delivery of salvaged materials to the City of Duluth at the location specified is included as part of the Remove Signal System pay items – no separate compensation will be made for hauling the materials to, and depositing the materials, at the location specified.

SS-2 (2565) TRAFFIC CONTROL SIGNALS

SS-2.1 DESCRIPTION

This Work consists of the following:

(1) Providing and installing materials, structures, and electrical equipment; ~~and installing City provided materials~~ as specified to complete two (2) operating new interconnected coordinated full-traffic-actuated traffic control signal systems in accordance with MnDOT 2565 "Traffic Control Signals," the Plans and these Special Provisions. Provide traffic control signal systems as follows.

TRAFFIC CONTROL SIGNAL SYSTEM "A" - at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue in the City of Duluth, St. Louis, County, and

TRAFFIC CONTROL SIGNAL SYSTEM "B" - at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive in the City of Duluth, St. Louis County.

(2) Providing and installing materials, and electrical equipment; removing and salvaging these items after the new permanent signal system is placed into operation; and providing for all labor and materials necessary to maintain operation of a traffic control signal system during each stage of construction, all to provide two (2) complete operating temporary traffic control signal systems as follows.

TEMPORARY SIGNAL SYSTEM "A" – at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue in the City of Duluth, St. Louis County, and

TEMPORARY SIGNAL SYSTEM "B" – at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive in the City of Duluth, St. Louis County.

SS-2.2 ACRONYMS

BLANK

SS-2.3 GENERAL

A Miscellaneous Items

Any mention of "Department" refers to the City of Duluth.

Location of poles, handholes, push button stations, foundations, and other signal components are shown in the Plans in their approximate location and will be determined in the field by the Engineer prior to installation.

Perform construction operations in the proximity of utility properties in accordance with the provisions of MnDOT 1507, except the first paragraph is hereby deleted and the following substituted therefore:

> It is the Contractor's own responsibility, prior to commencing work, to secure information and determine the exact location of any buried utility facilities as may exist, and to conduct operations in the vicinity of any such facilities in a manner that precludes damage thereto. The Contractor agrees to be fully responsible for any and all damages that might be occasioned by failure to exactly locate and preserve any and all underground utilities.

Ensure that each existing signal system is kept in operation <u>at all times,</u> unless otherwise

approved by the Engineer and the City of Duluth for a signal system to be turned off to facilitate signal-intersection construction or to switch from the existing signal system to temporary operation, and from temporary operation to the new permanent signal system. Do not turn-off an existing traffic control signal system without the specific approval of, and only in the presence of the Engineer. Notify the Engineer and the City of Duluth at least 48 hours in advance of scheduled turn-offs and before performing work on an existing traffic control signal system.

During any periods of authorized work suspension, City traffic personnel will provide and maintain the existing traffic signal cabinets and control equipment and will maintain the existing traffic control signal systems.

Ensure that a combination of the existing traffic signal system, temporary signal system, and/or the new permanent traffic signal system are kept in operation at all times during construction in accordance with the provisions of MnDOT 2565.3B and with the "***Temporary Signal System A-B***" Plans, except as follows:

The Contractor may request the City to turn-off a signal system for one period of two (2) consecutive calendar days (between Monday through Thursday only) for signal changeover operations. The traffic signal system must be operational by 3:00 pm on the second day, and shut down cannot occur until after 9:00 am on the first day.

The Contractor may also request that a signal system be periodically placed in flashing all-red operation to accommodate construction activities between the hours of 9:00 am and 3:00 pm, Monday through Thursday inclusive. The Contractor must request any additional flashing all-red operation periods at least 72 hours prior to when the flashing all-red operation is requested, and the City may accept or reject the request based on local traffic considerations.

Each signal system must be in operation at all times between the hours of 6:00 am-9:00 am and 3:00 pm-6:00 pm Monday through Friday unless otherwise approved.

Requests for a signal system to be turned off to accommodate service changeovers or other construction must be approved by the Engineer at least 72 hours prior to the request for a signal system to be turned off. Contractor must provide traffic control layouts to the Engineer for review, including any lane closures, at least 72 hours prior to the request for signal shut down.

All-way Stop signs and advance Stop Ahead signs (48" x 48", on both sides of the roadway) will be required during any signal shutdown (flashing all red operations and signal turn-offs) (incidental).

During construction of each new signal system, maintain operation of the temporary traffic signal systems and construct the new signal systems around each temporary signal system (as shown on the temporary signal plans). It is the Contractor's responsibility to provide and maintain all vehicle signal heads, luminaires, controller and service cabinets, and all components of each temporary signal system until each new signal system is able to be made operational. Temporary provisions for the existing signal systems include providing and installing temporary detection (video detection) needed to **maintain full actuation of each temporary signal system during construction**. Any cables, span wires, etc. needed to maintain operation of a signal system during construction are the responsibility of the Contractor to provide, install, maintain, and remove as part of the "Temporary Signal System A-B" pay items.

Within fifteen (15) days of the awarding of the Contract, provide evidence to the Engineer's satisfaction that all arrangements have been made with the Power Utility (Minnesota Power) to secure power to each new signal service cabinet. In this regard, it is the Contractor's responsibility to ensure that no delays occur to the signal construction or to the desired signal "turn-on" date, as determined by the Engineer.

SS-2.4 MATERIALS

A Conduit and Accessories

The following subsections from MnDOT Spec. 2565.2A "Conduit and Accessories" are deleted or deleted and replaced as follows.

A.1 Rigid Metal Conduit (RMC)

Specification heading and reference in MnDOT Spec. 2565.2A.1 "Rigid Steel Conduit (RSC) and Conduit Fittings" are deleted and replaced with the heading "Rigid Metal Conduit (RMC) and RMC Fittings" and referred to the "Rigid Metal Conduit (RMC)" section of these Special Provisions.

A.2 Intermediate Metal Conduit (IMC) and Conduit Fittings

Specification heading and reference in MnDOT Spec. 2565.2A.2 "Intermediate Metal Conduit (IMC) and Conduit Fittings" are deleted.

A.3 Non-Metallic Conduit

Specification heading and reference in MnDOT Spec. 2565.2A.3 "Non-Metallic Rigid PVC and HDPE Conduit" are deleted and replaced with the heading "Non-Metallic Conduit" and referred to the "Non-Metallic Conduit" section of these Special Provisions.

A.4 PVC Coated Rigid Metal Conduit (RMC)

Specification heading and reference in MnDOT Spec. 2565.2A.5 "PVC Coated Hot Dipped Galvanized Rigid Steel Conduit (PVC Coated RSC)" are deleted and replaced with the heading "PVC Coated Rigid Metal Conduit (RMC)" and referred to the "PVC Coated Rigid Metal Conduit (RMC) section of these Special Provisions.

B Rigid Metal Conduit (RMC)

Specification heading and language for MnDOT Spec. 3801, "Rigid Steel Conduit (RSC)" are deleted, and replaced with the heading "Rigid Metal Conduit (RMC) and the following:

Galvanized steel RMC includes the following if specified in the Contract as:

(1) Rigid Steel Conduit
(2) RSC
(3) Hot Dipped Galvanized RSC
(4) Galvanized Rigid Steel Conduit
(5) GRC

Provide RMC and associated fittings for electrical systems to construct a threadable raceway for protection and routing of conductors and cables.

Provide conduit hangers, clamps, straps, U-bolts, strut, and bar supports, threaded rod, inserts, and miscellaneous hardware for hanging and surface mounting RMC and PVC coated RMC in accordance with the NEC, as recommended by the conduit manufacturer, and as specified in the Contract, or, if not specified then as directed by the Engineer.

B.1 Galvanized Steel RMC

Provide Galvanized Steel RMC meeting the following:

(1) UL 6 "UL Standard for Safety Electrical Rigid Metal Conduit-Steel"
(2) ANSI C80.1 "Electrical Rigid Steel Conduit (ERSC)"
(3) Hot dip galvanize zinc coated inside and out

B.2 Fittings For Galvanized Steel RMC

Provide conduit bodies and fittings meeting the requirements of UL 514B, "UL Standard for Safety Conduit, Tubing, and Cable Fittings." Fittings included locknuts, bushings, conduit bodies, and elbows.

Provide threaded insulated grounding bushings for terminating the conduit raceway threaded ends inside enclosures such as junction boxes, handholes, and cabinets meeting the following requirements:

(1) Malleable iron
(2) Tinned copper lay-in lug
(3) UL 467 and UL 514B
(4) RoHS Compliant

C Intermediate Metal Conduit

MnDOT Spec. 3802, "Intermediate Metal Conduit" is deleted.

D Non-Metallic Conduit

Specification heading and language for MnDOT Spec. 3803, "Non-Metallic Rigid PVC and HDPE Conduit" are deleted, and replaced with the heading "Non-Metallic Conduit" and the following:

Provide non-metallic conduit and fittings for electrical systems as specified on the Plans.

D.1 Rigid Polyvinyl Chloride (PVC) Conduit

Use rigid PVC conduit and fittings meeting the following:

(1) NRTL listed meeting UL 651, "Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings".
(2) Gray in color
(3) Smooth interior and exterior surfaces
(4) Schedule 80 unless otherwise Schedule 40 on the Plans
(5) With the following marked on the outside:

(a) Manufacturer's name
(b) Conduit size
(c) Conduit type
(d) NRTL certification mark

D.2 High Density Polyethylene (HDPE) Conduit

Use HDPE continuous type conduit and fittings meeting the following:

(1) NRTL Listed and Labeled meeting UL 651
(2) Schedule 80
(3) Red or gray in color
(4) Smooth interior and exterior surfaces
(5) Marked with the following on the exterior:

(a) Manufacturer's name
(b) Size
(c) Type
(d) NRTL certification mark

E PVC Coated Rigid Metal Conduit (RMC)

Specification heading and language in MnDOT Spec. 3805, PVC Coated Hot Dipped Galvanized Rigid Steel Conduit (RSC)" are deleted and replaced with the heading "PVC Coated Rigid Metal Conduit (RMC)" and the following.

Provide City approved PVC coated RMC and fittings for electrical systems when specified in the Contract with approved hangers and supports.

E.1 PVC Coated Galvanized Steel RMC

Provide PVC coated galvanized steel RMC listed on MnDOT's APL-Lighting.

E.2 PVC Coated RMC Fittings

Provide PVC coated RMC fittings listed on MnDOT's APL-Lighting to use with PVC coated galvanized steel RMC.

Use fittings from the same manufacturer of the PVC coated RMC being used on the Project.

Refer to MnDOT Spec. 3839, "Conduit Expansion and Deflection/Expansion Coupling Fittings", for expansion and deflection/expansion coupling fittings.

E.3 Hangers and Supports for PVC Coated RMC

Use conduit hangers, clamps, straps, U-bolts, strut, and bar supports, threaded rod, inserts, and miscellaneous hardware for PVC coated RMC in accordance with the NEC, as specified by the PVC coated RMC manufacturers, and as shown on the Plans or, if not shown, as directed by the Engineer.

F Signal Head and Mounting Hardware

F.1 Angle and Straight Mount Caps

Provide angle and straight mount caps listed on MnDOT's APL-Signals

F.2 Clamp on Adapters

Provide clamp on adapters listed on MnDOT's APL-Signals

F.3 Cluster Head Adapters

Provide cluster head adapters listed on MnDOT's APL-Signals

F.4 Mast Arm Extensions

Provide mast arm extensions listed on MnDOT's APL-Signals

F.5 Plumbizers

Provide plumbizers listed on MnDOT's APL-Signals

F.6 Signal Head Mounting Spacers

Provide signal head mounting spacers listed on MnDOT's APL-Signals

F.7 Strap on, Bolt on, Threaded Hubs and Flanges

Provide strap-on hubs and flanges, bolt-on hubs and flanges, and threaded hub and flange pole adaptors listed on MnDOT's APL-Signals

G Emergency Vehicle Pre-emption (EVP) Equipment

Specification language in MnDOT Spec. 3814.3, "Sample and Testing" first paragraph, is deleted and replaced with the following:

Confirm and document the listing of the EVP systems, EVP Light Emitting Diode (LED) Confirmation Indications, and the EVP confirmatory indicator lamp holders on *Approved/Qualified Products List* under "Signals."

All new EVP system components to be provided by the Contractor must be the ***latest model GTT Opticom system components***, unless otherwise approved in writing by the Engineer prior to bidding of the project.

H Grounding Electrodes

Specification language in MnDOT Spec. 3818.1 Scope section is deleted and replaced with the following:

Provide grounding rod and plate electrodes to establish direct contact with the earth for the grounding electrode system, supplemental grounding, and auxiliary grounding on lighting systems, traffic signals systems, and other electrical systems.

Provide ground rod electrodes in accordance with MnDOT 3818 "Grounding Electrodes" and meeting the following:

(1) 10 foot long ground rod electrodes for light foundations and equipment pads
(2) 12 foot long ground rod electrodes in handholes
(3) 15 foot long ground rod electrodes for barrier and high top light foundations

I Handholes

Specification language in MnDOT Spec. 3819.1 Scope section is deleted and replaced with the following:

Provide handholes for use in City underground systems.

Specification language in MnDOT Spec. 3819.2 Requirements section is deleted and replaced with the following:

Use only handholes for non-deliberate heavy vehicular traffic unless otherwise shown on Plans.

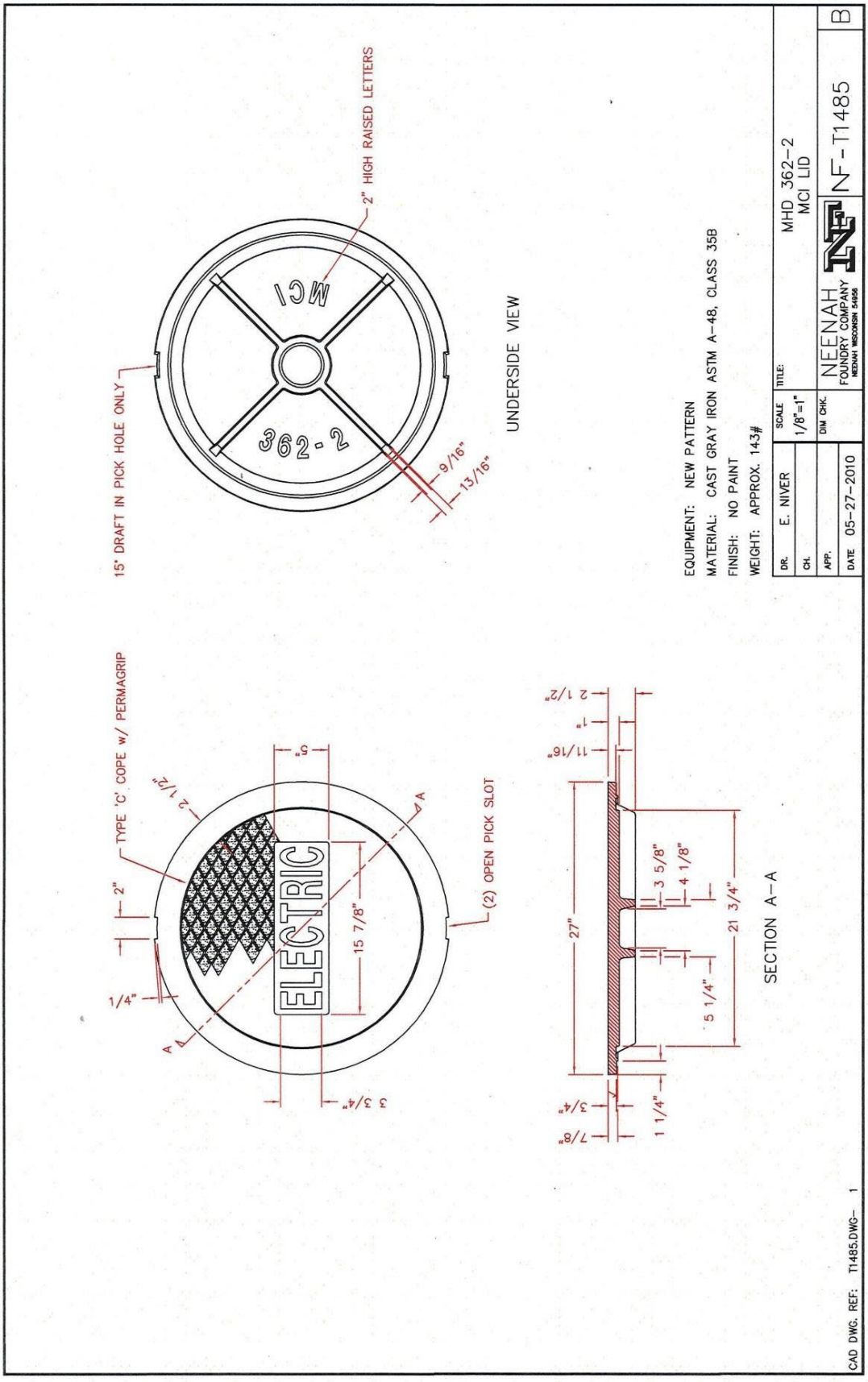
All handholes shall be PVC with modified metal frames and covers.

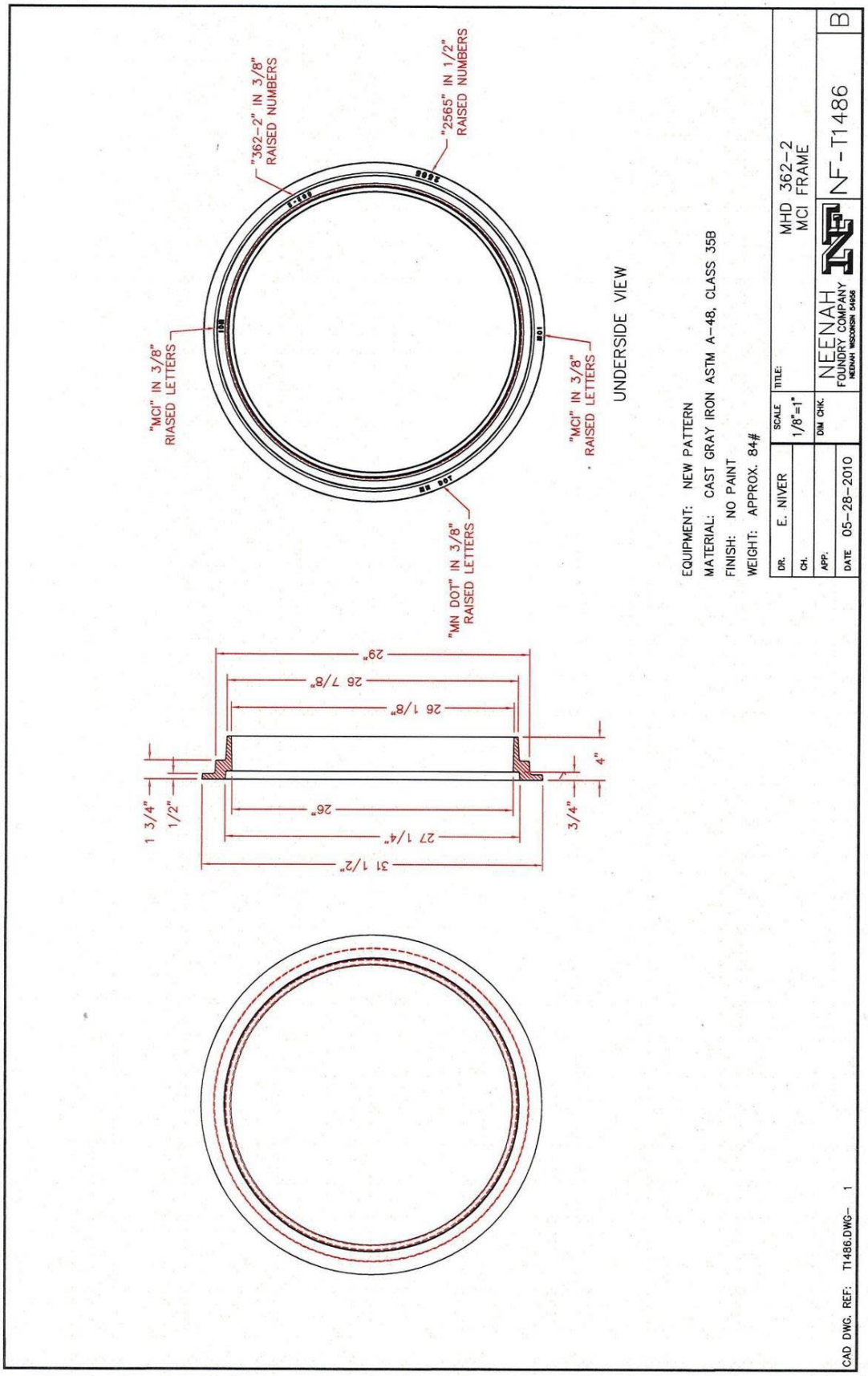
Only use handholes as specified in the Plans.

Emboss **"ELECTRIC"** on the cover for new traffic signal control handholes.

New handhole installations in boulevard (non-sidewalk) areas shall have a square concrete collar (per typical City details) provided and installed around these handholes (incidental).

The frame and casting cover for all handholes shall be modified according to the following drawings:


2" HIGH RAISED LETTERS
MCI
362-2
15° DRAFT IN PICK HOLE ONLY
9/16"
13/16"
UNDERSIDE VIEW
EQUIPMENT: NEW PATTERN
MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
FINISH: NO PAINT
WEIGHT: APPROX. 143#
DR. E. NIVER
CH.
APP.
DATE 05-27-2010
SCALE 1/8"=1"
DIM CHK.
TITLE: MHD 362-2 MCI LID
NEENAH FOUNDRY COMPANY
NEENAH WISCONSIN 54956
NF-T1485
B
TYPE 'C' COPE w/ PERMAGRIP
2"
1/4"
2 1/2"
5"
ELECTRIC
15 7/8"
3 3/4"
(2) OPEN PICK SLOT
A
A
SECTION A-A
2 1/2"
1"
11/16"
27"
3 5/8"
4 1/8"
21 3/4"
5 1/4"
3/4"
7/8"
1 1/4"
CAD DWG. REF: T1485.DWG- 1


"362-2" IN 3/8" RAISED NUMBERS
"2565" IN 1/2" RAISED NUMBERS
"MCI" IN 3/8" RAISED LETTERS
"MCI" IN 3/8" RAISED LETTERS
"MN DOT" IN 3/8" RAISED LETTERS
UNDERSIDE VIEW
29"
26 7/8"
26 1/8"
4"
1 3/4"
1/2"
26"
27 1/4"
3/4"
31 1/2"
EQUIPMENT: NEW PATTERN
MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
FINISH: NO PAINT
WEIGHT: APPROX. 84#
DR. E. NIVER
CH.
APP.
DATE 05-28-2010
SCALE 1/8"=1"
DIM CHK.
TITLE: MHD 362-2 MCI FRAME
NEENAH FOUNDRY COMPANY NEENAH WISCONSIN 54956
NF-T1486
B
CAD DWG. REF: T1486.DWG- 1

J 3830 Torque Wrench

Add the entire section:

3830.1 Scope

Use a torque wrench for tightening double nut anchor rod connections as required by MnDOT's Anchor Rod Tightening Handbook and in accordance with contract documents.

3030.2 Requirements

Use a torque wrench listed on MnDOT's APL-Lighting

3830.3 Sampling and Testing – Blank

K Build America Buy America

Use construction materials, and domestically manufactured products that are composed predominately of steel, iron, or both, for the permanent installation of MnDOT electrical systems, in accordance with MnDOT Division S Special Provisions *(1601) SOURCE OF SUPPLY AND QUALITY* requirements.

~~**L City Provided Materials**~~

~~The City of Duluth provides at no cost to the Contractor, the following materials and electrical equipment for the Contractor to install:~~

(1) ~~Two (2) traffic control signal cabinets, each complete with an actuated controller unit and signal control equipment~~

~~All required anchor rods, nuts, and washers for each City provided controller cabinet (four sets per cabinet, with one set including one anchor, one nut, and one washer) and all required rubber gasketing for each cabinet (to be installed between the bottom of each cabinet and the cabinet concrete equipment pad) MUST BE PROVIDED AND INSTALLED BY THE CONTRACTOR.~~

M Contractor Provided Equipment for Traffic Control Signal Cabinets

Contractor provided equipment for each ~~City~~ CONTRACTOR provided controller cabinet includes EVP phase selectors, APS central control units, and video image processors. Equipment shall be integrated into each ~~City~~ CONTRACTOR provided traffic control signal cabinet by the Contractor.

N MnDOT Approved Products Materials List Form

The following document may be used for the required submittal list to record APL products used on the Project in accordance with MnDOT 2565.3A.9 "MnDOT Approved Products List".

MnDOT's Approved/ Qualified Products List				
Contractor Name, Address, Phone Number (modify this line, remove in place text and replace it with required information)				
TH				
County				
S.P. Number				
APL product category	Name of Manufacturer	Name of Product	Catalog Number	Quantity

A copy of the document can be downloaded by following the link below.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=30669886

O Virgin Granular and Aggregate Material

Provide Virgin Granular and Aggregate Material for subbase and backfill in accordance with MnDOT 3138.2B “Virgin Materials”, MnDOT 3149.2A.1 “Virgin Materials” and the following.

O.1 Backfill for Foundations

Provide excavation and backfill in accordance with MnDOT 2565.3C “Excavation and Backfill” and the following.

When required in Contract Documents or as directed by the Engineer to use a Granular or Aggregate Material in accordance with MnDOT 3138 “Aggregate for Surface and Base Courses” or MnDOT 3149 “Granular Materials” to backfill around foundations, provide Virgin Material as specified. Do not use Recycled Material.

O.2 Subbase for Equipment Pads

Provide a 6 inch thick compacted subbase layer of Virgin Class 5 Aggregate Material in accordance with MnDOT 3138 for all equipment pads. Do not use Recycled Material.

Excavate equipment pad area and install the subbase layer for equipment pads, in accordance with "Equipment Pad Excavation and Subbase" in the Construction Requirements section of these Special Provisions.

O.3 Conduit Buried in Aggregate Material

When required to open trench rigid PVC conduit in an existing aggregate material, provide a trench bedding with a Virgin Aggregate Material bedding in accordance with MnDOT 3149.2G "Aggregate Bedding". Do not use Recycled Material.

Install the conduit in the open trench with the Virgin Aggregate Material bedding in accordance with Conduit Buried in Aggregate Material and Concrete Encased Conduit in the Construction Requirement section of these Special Provisions.

P Serrated Eight-Sided Lock Nuts for Vehicle and Pedestrian Signal Heads

Furnish and install aluminum, eight-sided, serrated lock nuts for fastening the vehicle and pedestrian signal heads to the traffic signal bracketing and plumbizers meeting the following:

(1) Made from material A384.0-F (ADC12)/A413.0-F
(2) Threaded National Pipe Straight class M (NPSM)
(3) Computer Numerical Control (CNC) machined Qualified

Q Splice Connectors in Pole Bases

MnDOT 2565.3I.5 "Pole Base Connectors" and MnDOT 2565.3I.7 "Terminal Blocks" are deleted and replaced with the following.

Splices are <u>not</u> allowed in traffic signal pole bases unless otherwise specified on the Plans.

R Torque Wrench

Use approved electric and hydraulic torque wrench listed on MnDOT's APL-Signals on the top nuts to tighten traffic signal mast arm pole anchor rods to the required torque values specified in the MnDOT *Anchor Rod Tightening Handbook*. Use a working handheld digital pendant or, digital or analog gauge with the torque wrench to ensure specified torque values have been met and can be verified in foot pounds by the installer and inspector during the tightening process.

If the gauge display is in pounds per square inch (PSI), convert PSI to foot pounds and ensure the calculations are correct. Submit the PSI to foot pounds converted values to the Engineer before installing the poles. The submittal and Engineer's review does not relieve responsibility for tightening anchor rods to the required torque values.

Obtain Engineer's approval of the wrench and provide proof of calibration from an accredited calibration service in accordance with MnDOT Spec. 2565.3A.13 "Calibration Requirements for Measurement Tools and Test Equipment" before installing the poles.

S Anchor Rods

Provide anchor rods in accordance with MnDOT 3385 "Anchor Rods", except provide rods with both the supplementary requirement S3 for permanent marking and color-coding on the end of the rod with the grade identification.

T Backplates

Provide backplates as required in MnDOT 3834.2A.3 and as follows:

(1) Provide reflectorized backplates

U Cluster Head Adapters

Provide Cluster Head Adapters at locations shown on the Plan.

Use MnDOT approved cluster head adapters listed on MnDOT's APL-Signals:

http://www.dot.state.mn.us/products/signals/index.html

V Bi Modal Green and Yellow Arrow Signal Indications

Provide green and yellow bi-modal signal indications at locations shown on the Plan.

Use MnDOT approved bi-modal signal indications listed on MnDOT's APL-Signals:

http://www.dot.state.mn.us/products/signals/index.html

W APS Push Button Stations

Provide 60-inch long aluminum shafts instead of the typical 48-inch long shaft. Overall height will be 5'-9" with base and shaft.

X Accessible Pedestrian Signals (APS)

Provide Accessible Pedestrian Signals in accordance with MnDOT Spec. 3833 "Accessible Pedestrian Signal Push Buttons and Mounting Hardware" and as follows:

All new APS push button installations on traffic signal mast arm poles must also have a City approved APS mast arm pole adaptor provided and installed by the Contractor in accordance with the Plans and the MnDOT Approved/Qualified Products List.

All new APS push button installations on traffic signal pedestal poles must also have City approved APS pedestal pole spacers (3 per push button installation) provided and installed by the Contractor in accordance with the Plans and the MnDOT Approved/Qualified Products List.

Present the order form in this section to the APS manufacturer to ensure the braille message is added to the pedestrian information sign and the correct voice messages are programmed in the pedestrian push buttons.

The top half of the form below can be downloaded by following the link.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=36421074

Accessible Pedestrian Signal (APS)
ORDER FORM
Intersection: Railroad Street at Canal Park Drive/North Lake Avenue

Total Number of Pedestrian Push Buttons Qty: 8

Field Wiring Interface Board: One needed for each intersection Qty: 1

CCU (Central Control Unit): One needed for each intersection Qty: 1

Push Button and Sign Braille Information

Button	**Arrow Direction R/L**		**Street Name (**Street Being Crossed**)**
PB2-1	Left	PB2-1	Railroad Street
PB2-2	Right	PB2-2	Railroad Street
PB4-1	Left	PB4-1	Lake Avenue
PB4-2	Right	PB4-2	Lake Avenue
PB6-1	Left	PB6-1	Railroad Street
PB6-2	Right	PB6-2	Railroad Street
PB8-1	Left	PB8-1	Canal Park Drive
PB8-2	Right	PB8-2	Canal Park Drive

Custom Voice Message Details

Voice on Location and Walk Message(s) Please give phonetic pronunciation on difficult street names so that the message will be recorded correctly.
*Note that unless Street, Drive, Avenue etc.…are necessary for intersection identification, it is recommended to not include them in the verbal message.
The bottom half form below can be downloaded by following the link.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=28204324

PB2-1

Wait Message: **Wait to Cross**	**Railroad Street** (Street Being Crossed)	**at**	**Lake Avenue** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)

PB2-2

Wait Message: **Wait to Cross**	**Railroad Street** (Street Being Crossed)	**at**	**Canal Park Drive** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)

PB4-1

Wait Message: **Wait to Cross**	**Lake Avenue** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Avenue** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Avenue** (Street Being Crossed)

PB4-2

Wait Message:			
Wait to Cross	**Lake Avenue** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Avenue** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Avenue** (Street Being Crossed)

PB6-1

Wait Message:			
Wait to Cross	**Railroad Street** (Street Being Crossed)	**at**	**Canal Park Drive** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)

PB6-2

Wait Message:			
Wait to Cross	**Railroad Street** (Street Being Crossed)	**at**	**Lake Avenue** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)

PB8-1

Wait Message:			
Wait to Cross	**Canal Park Drive** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Canal Park Drive** (Street Being Crossed)	**Walk sign is on to cross**	**Canal Park Drive** (Street Being Crossed)

PB8-2

Wait Message:			
Wait to Cross	**Canal Park Drive** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Canal Park Drive** (Street Being Crossed)	**Walk sign is on to cross**	**Canal Park Drive** (Street Being Crossed)

Accessible Pedestrian Signal (APS)
ORDER FORM
Intersection: Railroad Street at South Lake Avenue/Lake Place Drive

Total Number of Pedestrian Push Buttons	Qty: 8
Field Wiring Interface Board: One needed for each intersection	Qty: 1
CCU (Central Control Unit): One needed for each intersection	Qty: 1

Push Button and Sign Braille Information

Button	**Arrow Direction R/L**		**Street Name (**Street Being Crossed**)**
PB2-1	Left	PB2-1	Lake Place Drive
PB2-2	Right	PB2-2	Lake Place Drive
PB4-1	Left	PB4-1	Railroad Street
PB4-2	Right	PB4-2	Railroad Street
PB6-1	Left	PB6-1	Lake Avenue
PB6-2	Right	PB6-2	Lake Avenue
PB8-1	Left	PB8-1	Railroad Street
PB8-2	Left	PB8-2	Railroad Street

Custom Voice Message Details

Voice on Location and Walk Message(s) Please give phonetic pronunciation on difficult street names so that the message will be recorded correctly.
*Note that unless Street, Drive, Avenue etc….are necessary for intersection identification, it is recommended to not include them in the verbal message.
The bottom half form below can be downloaded by following the link.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=28204324

PB2-1

Wait Message: **Wait to Cross**	**Lake Place Drive** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Place Drive** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Place Drive** (Street Being Crossed)

PB2-2

Wait Message: **Wait to Cross**	**Lake Place Drive** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Place Drive** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Place Drive** (Street Being Crossed)

PB4-1			
Wait Message: **Wait to Cross**	**Railroad Street** (Street Being Crossed)	**at**	**Lake Place Drive** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)
PB4-2			
Wait Message: **Wait to Cross**	**Railroad Street** (Street Being Crossed)	**at**	**Lake Avenue** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)
PB6-1			
Wait Message: **Wait to Cross**	**Lake Avenue** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Avenue** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Avenue** (Street Being Crossed)
PB6-2			
Wait Message: **Wait to Cross**	**Lake Avenue** (Street Being Crossed)	**at**	**Railroad Street** (Intersecting Street)
Walk Message:	**Lake Avenue** (Street Being Crossed)	**Walk sign is on to cross**	**Lake Avenue** (Street Being Crossed)
PB8-1			
Wait Message: **Wait to Cross**	**Railroad Street t** (Street Being Crossed)	**at**	**Lake Avenue** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)
PB8-2			
Wait Message: **Wait to Cross**	**Railroad Street** (Street Being Crossed)	**at**	**Lake Place Drive** (Intersecting Street)
Walk Message:	**Railroad Street** (Street Being Crossed)	**Walk sign is on to cross**	**Railroad Street** (Street Being Crossed)

Y Signal Service Cabinet (Non-SSB, with Battery Back-up Equipment)

Provide signal service cabinets in accordance with MnDOT Spec. 3837.2A.7, the details in the Plans, and as follows:

Non-SSB service cabinet with battery back-up equipment that includes an inverter, batteries, bypass switch, and external strobe.

Z Video Detection System

Provide, install, and make operational all video detection devices as shown in the Plans and as follows (for Signal Systems A and B).

Cameras to be provided and installed by the Contractor shall be Autoscope Vision as manufactured by Econolite Control Products Inc. or Engineer-approved equal.

Provide and install all cables, conductors, mounting hardware and all other equipment necessary to make operational each video detection device as per the Plans and to the satisfaction of the Engineer.

All other equipment necessary in the traffic signal cabinet to operate the video detection system at Signal Systems A and B, including but not limited to monitor and Com Manager board, shall be provided and installed by the Contractor, and shall be new and fully compatible with Autoscope Vision (or Engineer-approved equal) cameras.

The video cable shall be Autoscope Branch Cable or Engineer-approved equal. The cable is comprised of power limited tray cable as follows: 3 conductor #18 AWG (19X#30) extruded polyethylene insulation, overall beldfoil shield with an 18 AWG tinned copper drain wire. Overall polyethylene jacket with nylon ripcord and color coded.

AA Controller Cabinet Complete with Internal Cabinet Equipment

Description for Minimum Specifications for TS2 Type 1 Traffic Signal Controller Cabinet with Controller:

This specification describes for the Contractor to furnish, install, and make operational:

(1) Two (2) NEMA TS2 Type 1 traffic signal control cabinets, each with controller and Malfunction Management Unit, ready for testing by manufacturer/supplier staff and subsequent installation by the Contractor at each new Traffic Control Signal System.

General Requirements:

The manufacturer shall assemble each new cabinet conforming to the latest revision of NEMA Standards Publication TS 2 Version 2.06 (R2008) with Amendment 3-2009, Traffic Controller Assemblies with NTCIP Requirements, National Electrical Manufacturers Association, hereinafter called NEMA TS2 Standard. Where differences occur, this specification shall govern.

Provide arc flash protection within each new cabinet as needed to satisfy NFPA 70E and OSHA requirements.

Any additions, deletions or variations from the following specifications must be stated. Reason for variations and deviations must also be stated. These specifications shall be construed as minimum. Should the manufacturer's current published data or specifications exceed these, they shall furnish evidence upon request that the model to be furnished has been commercially available to the trade for a period of not less than one year.

Cabinet Manufacturer Qualifications:

The cabinet manufacturer shall be ISO 9001-2021 Registered and have been certified in the IPC "Class II" Electronics standards and training for all manufacturing staff to ensure manufacturing quality, documentation, and proper going/continuing employee training for manufacturing processes by IPC Certified Trainers. Each new cabinet shall have been in production for a minimum of 5 years and have a UL508A listing for Industrial Control Panel Enclosure.

Cabinet Design and Construction:

1. Each new cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.

2. Each new cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.

3. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.

4. A 40-inch din rail should be incorporated, mounted on the back wall above the top shelf.

5. The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.

6. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blow holes and other irregularities. All sharp edges shall be ground smooth.

7. Each new cabinet shall be supplied with anti-Graffiti coating and sufficient care shall be taken in handling to insure that scratches are minimized.

8. All seams shall be sealed with RTV sealant material on the interior of the cabinet.

9. Each new cabinet shall be supplied with a minimum of three (3) removable shelves, manufactured from 5052-H32 aluminum. Shelves shall be a minimum of 10 inches deep, with back stop to prevent items from rolling off of the back of the shelf. One Computer Drawer Shall Be included with the cabinet and mounted on the lowest shelf.

10. Shelves shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. Shelves shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelves on the front sidewall mounting studs. Shelves shall be held in place by a nylon tie-wrap inserted through holes on the front edge of the shelf and around the front sidewall mounting studs.

11. The front edge of the shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses.

12. A minimum of one set of vertical "C" channels (in addition to the set for the shelves) shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet

components. The channels shall accommodate spring mounted nuts or studs. All mounting rails shall extend to within three and one-half (3.5) inches of the top and bottom of the cabinet. Sidewall rail spacing shall be 7.88 inches center-to-center. Rear wall rail spacing shall be 18.50 inches center-to-center.

13. Lifting tabs shall be mounted on either side of the cabinet to allow to for the cabinet to be lifted into place. The lifting tabs shall be able to be mounted so that they extend above the cabinet for lifting, **and then rotated down as to not interfere with the box for the cabinet**.

14. The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.

15. The lower section of the cabinet door shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, 12”x16” metal filter cover shall cover the removable air filter. The filter shall fit snugly against the cabinet door wall. The metal filter cover shall be secured in place by a swivel spring- loaded retaining arm. The metal filter cover shall be louvered downward such as to force any water spray towards the bottom of the cabinet.

16. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.

17. The main door on the cabinet shall be equipped with a three-point latching mechanism.

18. The handle on the main door to the cabinet shall utilize a shank of 5/8 inches minimum diameter. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open.

    The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.

19. The main door hinge shall be attached in such a manner that no rivets or bolts are exposed.

20. The main door shall include a mechanism capable of holding the door open at approximately 90, 125, and 150 degrees under windy conditions. Manual placement of the mechanism shall not be required by field personnel.

21. Equip the main door with a Corbin tumbler lock or exact equivalent. Minimum of two keys shall be supplied. Provide with the police door-in-door a Corbin treasury type lock or exact **equivalent and a minimum of one key for each cabinet.**

22. Four (4) three-quarter (3/4) inch galvanized anchor bolts shall be supplied with each controller cabinet to provide proper installation.

23. The cabinet flange for securing the cabinet to the anchor bolts shall not protrude outward from the bottom of the cabinet. A set of one-half (1/2) inch thick rubber mounting gaskets shall be supplied with each controller cabinet to provide proper seal between the cabinet flange and the concrete foundation.

24. Each cabinet shall be of sufficient size to accommodate all equipment. The minimum cabinet size shall be as follows:

    65”H x 44” W x 24” D (for controller cabinet).

25. Each new cabinet shall be the manufacturer's latest model and design.

Terminals and Facilities/Main Panel Design and Construction:

1. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed so as to minimize flexing when plug-in components are installed.

2. All 16-position main panels shall be provided with a mounting mechanism that allows easy access to all wiring on the rear of the panel without the removal of any cabinet shelves. Lowering or complete removal of the main panel can be accomplished without the use of hand tools.

3. The terminals and facilities shall be available as a minimum in the following configuration:

    Sixteen load switch sockets, six flash transfer relay sockets, one flasher socket, two main panel BIU racks with two BIUs, one 16 channel detector rack with one BIU, and one Type-16 MMU.

4. All load switch and flash transfer relay socket reference designators shall be silkscreen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.

5. A maximum of eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in two horizontal rows.

6. All load switches shall be supported by a bracket, extending at least half the length of the load switch.

7. Rack style mounting shall be provided to accommodate the required BIUs per the configuration listed above. A dual-row, 64-pin female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides shall be provided for both edges of the BIU. Terminal and facilities BIU mounting shall be an integral part of the main panel. Detector rack BIU mounting shall be an integral part of the detector rack.

8. All BIU rack connectors shall have pre-wired address pins corresponding to the requirements of the TS2 specification. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.

9. The 16-load switch position main panel shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.

10. All field output circuits shall be terminated on a non-fused barrier type terminal block with a minimum rating of 10 amps. Each terminal block position shall have two No. 10/32 screw connectors and a removable shorting bar. Each field side terminal shall be equipped with a Ilsco Terminal Lug 4-14 AL9CU, No substitutes.

11. All field output terminal blocks shall utilize spade lugs to terminate pack panel wiring. All back panel wires meant for technician servicing and modifying shall be labeled per original manufacture termination location.

12. All field input/output (I/O) terminals shall be identified by permanent alphanumerical labels. All labels shall use standard nomenclature per the NEMA TS2 specification.

13. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver.

14. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.

15. Field terminal blocks and the screwlugs used to connect the field wiring shall be provided a clear plastic protective cover mounted on plastic standoffs to allow quick removal and access while providing electrical shock protection while working in the cabinet.

16. The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length.

17. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.

18. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.

19. At a minimum, three 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and nonprogrammable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.

20. All main panel wiring shall conform to the following wire size and color:

Green/Walk load switch output	• Brown wire • 14 gauge
Yellow load switch output	• Yellow wire • 14 gauge
Red/Don't Walk load switch output	• Red wire • 14 gauge
MMU (other than AC power)	• Violet wire • 22 gauge
Controller I/O	• Blue wire • 22 gauge
AC Line (power panel to main panel)	• Black wire • 8/10 gauge
AC Line (main panel)	• Black wire • 10 gauge
AC Neutral (power panel to main panel)	• White wire • 8/10 gauge
AC Neutral (main panel)	• White wire • 10 gauge
Earth ground (power panel)	• Green wire • 8 gauge
Logic ground	• Gray wire • 22 gauge
Flash programming	• Orange wire Flasher Terminal • Black, Red or Yellow wire Field Terminal • 14 gauge

21. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.

22. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie-wraps or interwoven cables are unacceptable.

23. All terminals and facilities configurations shall be provided with sufficient RS485 Port 1 SDLC communication cables to allow for the intended operation of that cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications. Cable used for SDLC cables shall be a Belden 8104.

24. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.

25. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.

26. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.

27. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be separated, earth ground from the other two.

28. The main panel shall incorporate a relay to remove +24 VDC from the common side of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting.

29. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

30. All 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. Lap joint soldering is not acceptable.

31. An 80-position fuse block shall be wired to the field side of the Terminal and Facilities out puts. The fuse block shall accommodate Flashing Yellow Arrow Operations.

32. An AAPS terminal block shall be installed and wired to accommodate AAPS systems.

33. The back panel shall hinge down to allow for technicians to easily access the rear of the panel. The silk screen on the back of the panel shall be upside down to all for it to be read correctly once hinged down.

Power Panel Design and Construction:

1. The power panel shall consist of a separate module, securely fastened to the right side wall of the cabinet. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and power bus assembly. It shall be manufactured from 0.090-inch, 5052-H32 aluminum with a removable plastic front cover which shall be arc flash protection rated and comply with NFPA 70E and OSHA requirements.

2. The panel shall be of such design so as to allow a technician to access the main and auxiliary breakers without removing the front cover.

3. The power panel shall house the following components:

a. A minimum of a 40-amp main breaker for the 16- position cabinet. This breaker shall supply power to the controller, MMU, signals, cabinet power supply and auxiliary panels, and a 40-amp breaker to supply the flasher power. Breakers shall be at minimum, a thermal magnetic type, U.L. listed for HACR service, with a minimum of 10,000 amp interrupting capacity.

b. A minimum of a 15-amp auxiliary fuse. This fuse shall supply power to the fan, light and GFI utility outlet.

c. An EDCO model SHP-1250 surge arrester.

d. A 50 amp, 125 VAC radio interference line filter.

e. A SPST-NO Crydom A4890 solid state relay shall be used for the signal buss relay.

f. Neutral buss shall be a 30 position, triple stack, with mounting base as manufactured by ILSCO.

g. Grounding buss shall be a 20 position, double stack, with mounting base as manufactured by ILSCO.

h. A NEMA type 5-15R GFI utility outlet.

i. A 4-position plug-in connector for wiring to the power bus assembly.

Power Bus Assembly:

1. The power bus assembly shall be manufactured from 0.090 inch, 5052-H32 aluminum. It shall provide filtered power for the controller, malfunction management unit, cabinet power supply, and all auxiliary equipment. It shall include the SDLC Bus connecting cables wired into a surface mounted compression terminal block.

2. The Power Bus Assembly shall house the following components:

   a. Six (6) power connectors.

   b. Two terminal strips to hardwire the power connections.

   c. SDLC terminal block with six (6) pre-wired cables.

3. All cabinet equipment requiring filtered power to operate, shall be connected to the power bus assembly by a Burndy connector # SMS12PDH1, or hardwired directly to the supplied terminal blocks.

Auxiliary Cabinet Equipment:

1. Each new cabinet shall be provided with a thermostatically controlled (adjustable between 80-150 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan plate shall be removable with the use of simple hand tools for serviceability. A minimum of one exhaust fan shall be provided. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute. The Fan/Thermostat assembly shall be connected to the Power panel by means of a 4-position plug-in cable. Two thermostatically controlled heat lamps sockets shall be installed in the cabinet

2. At minimum, two light panels shall be mounted in each new cabinet to sufficiently illuminate the field terminals. The light panels shall be wired to a 15-amp ON/OFF toggle switch mounted on the power panel.

3. A resealable print pouch shall be mounted to the door of each new cabinet. The pouch shall be of sufficient size to accommodate one complete set of cabinet prints.

4. Set up each new cabinet with a spare quad outlet.

Vehicle Detection:

1. A minimum of one vehicle detector amplifier rack shall be provided in each new cabinet.

2. Each detector rack shall support up to 16 channels of loop detection (either eight 2 channel detectors or four 4 channel detectors), two 2-channel preemption devices and one BIU.

3. Each new cabinet shall contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers. The panels shall be manufactured from FR4 G10 fiberglass, 0.062 inches thick, with a minimum of 2 oz. of copper for all traces and built to the IPC “Class II” Electronics standards

4. Spade lugs are not required for termination of loop and EVP field wire. The detector interface panel shall provide a barrier terminal strip to all for direct wire termination.

5. An 8-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to a mounting plate and attached to the left side of the cabinet.

6. Each interface panel shall allow for the connection of sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.

7. Each interface panel shall provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.

8. Lightning protection device mounting holes shall be provided to accommodate an Edco SRA-16C, or Edco SRA-6, or Edco LCA-6, or a varistor lightning protection device.

9. A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color coded red and white wire.

10. All termination points shall be identified by a unique number and silk screened on the panel.

11. Each detector rack shall accommodate rack mountable preemption devices such as EMTRAC or Opticom.

12. Each detector rack shall be powered by the cabinet power supply and be connected to the power bus assembly by means of Burndy connector # SMS12PDH1.

13. The card rack shall have provisions to attach a marking strip or other identification labels to identify detector modules and/or specific intersection loops.

14. No loop detector amplifier cards are required to be provided and installed by the Contractor for either signal system. Instead, the Contractor is responsible for providing, installing, and making operational all required cabinet components needed to make video detection operational for each new controller cabinet being used for both Signal Systems.

Cabinet Test Switches and Police Panel:

1. A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following:

   a. AUTO/FLASH SWITCH. When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. If required by the plans and specifications, an optional RC network shall be provided to give the controller an external start pulse when switch is returned to the auto position. This will force the controller to initiate the start-up sequence when exiting flash.

   b. STOP TIME SWITCH. When applied, the controller shall be stop timed in the current interval.

   c. CONTROL EQUIPMENT POWER ON/OFF. This switch shall control the controller, MMU, and cabinet power supply AC power.

2. Momentary test push buttons for all vehicle and pedestrian inputs to the controller are not required. The TS2 controllers to be provided with the cabinet assemblies shall provide vehicular and pedestrian call inputs from its keyboard while in the standard status display.

3. The police door switch panel shall contain the following:

   a. SIGNALS ON/OFF SWITCH. In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.

b. AUTO/FLASH SWITCH. In the flash position, power shall not be removed from the controller and stop time shall be applied. If required by the plans and specifications, an optional RC network shall be provided to give the controller an external start pulse when switch is returned to the auto position. This will force the controller to initiate the start-up sequence when exiting flash.

4. All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.

5. Any exposed terminals or switch solder points shall be covered with a nonflexible shield to prevent accidental contact.

6. All switch functions must be permanently and clearly labeled.

7. All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.

8. All test switch panel wiring shall be connected to the main panel via a 36-pin Burndy connector #SMS36R1.

9. All wiring from the main panel to the test switch panel shall be connected to the switch panel via a 24-pin Burndy connector #SMS24R1.

Auxiliary Devices:

1. Load Switches:

   Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.

   Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load.

   The front of the load switch shall be provided with at least three indicators to show, at minimum, the input signal from the controller to the load switch.

   Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.

   The full complement of load switches shall be supplied by the Contractor with each new cabinet (plus 2 spare load switches to be left in each cabinet for future use by others) to allow for maximum phase utilization for which the cabinet is designed.

2. Flashers:

   Each flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.

   Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.

The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM.

3. Flash Transfer Relays:

   All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.

   The coil of the flash transfer relay must be de-energized for flash operation.

   The full complement of relays shall be supplied with each new cabinet to allow for maximum phase utilization for which the cabinet is designed.

4. Malfunction Management Units:

   Each new cabinet assembly shall be supplied with a new Malfunction Management Unit (MMU) as defined by the requirements of Section 4 of the NEMA TS2 Standard.

   MMU unit shall be Reno MMU2-1600GE with Ethernet capabilities. Each new MMU unit shall be provided, installed, and made operational by the Contractor.

5. Bus Interface Units:

   All Bus Interface Units (BIUs) shall meet the requirements of Section 8 of the NEMA TS2 Standard.

   The full complement of Econolite Control Products, Inc. Model 160-1003-502 Bus Interface Units shall be supplied with each new cabinet to allow for maximum phase and function utilization for which the cabinet is designed.

   Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.

6. Cabinet Power Supply:

   The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.

   The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.

   The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.

   One Econolite Control Products, Inc. Model 1084-003 cabinet power supply shall be supplied with each new cabinet assembly and shall be wired directly to the Power Bus Assembly via a Burndy 12-pos #SMS12PDH1 connector.

7. Controller Unit:

   Each new cabinet assembly shall be supplied with one (1) new signal controller. Each new controller unit shall be a new Econolite Cobalt TS2 Type 1 shelf mount controller with data key, Ethernet connection and EOS software.

Each new controller shall be manufacturer's most current model.

8. Fiber Connectivity:

All required Ethernet ports shall be provided to connect each traffic signal controller cabinet, controller unit, conflict monitor, video vehicular detection system to the City's existing fiberoptic trunk line and system, so that the City has full capability to view and monitor signal system cameras and components over their trunk fiber line at offsite facilities (such as at City Hall).

a The connection shall support 10/100/1000 Mbps Ethernet communication.

b The communications interface panel shall proxy all network requests that arrive on the fiber connection to avoid unwanted network traffic from reaching the broadband-over-power network between the communications interface panel and each traffic signal system component.

c All communications shall be to a single IP address.

d The system shall be able to provide Full HD quality video through its' WAN port for use in streaming video back to any remote location.

e The maintenance port shall support DHCP to automatically assign an IP address to the user's computer.

f The communications interface panel shall provide the required connections to communicate to the traffic controller through the cabinet.

g The traffic controller connection shall support a TS2 Type 1 compatible SDLC interface.

h The traffic controller connector shall be a 15-pin female metal shell D sub-miniature type connector to support a standard NEMA TS2 or TEES SDLC cable.

i The traffic controller connection shall support a protocol interface to SDLC-capable traffic controllers (NEMA or TEES).

j The traffic controller connection shall support the NEMA TS2 SDLC protocol to include up to 64 detector outputs and 32 inputs.

k The traffic controller connection shall be able to connect to a wired input/output card, which supports wired I/O in cabinets without a SDLC-capable controller.

l It shall be possible to connect and use both SDLC communications and communication to the wired input/output card simultaneously.

m Each communications interface panel shall include two USB 2.0 ports.

n If a communications interface panel fails to start and run due to a software or operating system failure, it shall be possible to reinstall all system and application software from a USB memory stick without necessitating removal of the communications interface panel from the cabinet.

o Video recording of up to 2 cameras, or of 1 camera plus the quad view simultaneously, shall commence automatically when an appropriately configured USB memory stick is installed in either USB port.

p The Contractor is responsible for providing all required materials and electrical equipment within each new traffic signal controller cabinet (and also to the adjacent battery back-up service cabinet) and completing all required connections needed to make the fiberoptic connection between each cabinet and the City's remote facilities (via the existing City fiberoptic trunk cable) fully operational so that City has full capabilities to access each controller cabinet component listed above, all video and surveillance cameras, and the battery back-up service equipment and view live video streaming from both the video detection system cameras and any future PTZ cameras (incidental).

Documentation:

Cabinet Intersection Wiring Diagrams. At the time of the new cabinet delivery, furnish with each new cabinet two sets of printed 11x17-inch cabinet intersection wiring diagrams and one set of .dwg CAD files for the cabinet.

Acceptance Testing:

The City reserves the right to perform its own tests on the traffic signal cabinet at any time using the owner's equipment. Should a traffic signal cabinet be found to not meet the requirements of these specifications, the vendor shall be responsible for all repairs / revisions as necessary to bring the traffic signal cabinet into conformance with these specifications within two (2) working days of written notification and at no additional cost to the Owner.

In the occurrence of a traffic signal cabinet failing the acceptance testing as defined in these specifications, the Owner will provide written notification of defect. The vendor has 24 hours to correct the defect and pass additional acceptance testing. Sending an email, hand completion of a defect notice and handing it to the vendor's field technician, or other means of written correspondence constitutes notification.

Manufacturer/Vendor Testing, Warranty and Support:

1. Testing:

   Each new controller and cabinet assembly shall be tested as a complete entity under signal load.

   Each new assembly shall be delivered with a signed document detailing the cabinet final tests performed.

   Each new cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

2. Warranty and Support:

   New controllers and Malfunction Management Units shall be warranted by the manufacturer against mechanical and electrical defects for a period of **two (2) years** from date of shipment. The manufacturer's warranty shall be supplied in writing with the cabinet and controller. Second party extended warranties are not acceptable.

   Each new cabinet assembly and all other new components shall be warranted for a period of one year from date of shipment.

The warranty shall provide for full repair or replacement, as determined by the Owner, of the failed item or cabinet system, including removal and installation, at no cost to the Owner. Vendor warranty service response times depend on whether or not the Owner has spare inventory of the failed item. In the event that there is an issue with either the cabinet itself, or a component for which the Owner does not maintain an inventory, response times after notification by the Owner are as follows:

- 4 hours to have qualified service personnel on site at the intersection
- 12 hours to have the signal safely operational, including all phases and enough detection to run the intersection phasing.
- 2 business days to restore the signal to full original operations

The vendor is responsible for further evaluation and diagnosis of the problem and determination of the specific cause of the problem.

In the event of a failure of an item under warranty that the Owner has spare equipment in stock, the vendor will be notified in writing of the failure and will be responsible for all costs associated with shipping the warrantied item (from) and its replacement item (to) the Owner. The replacement items should arrive at the Owner within five (5) working days of notification.

The Owner reserves the right to make repairs to malfunctioning cabinet and equipment that are under warranty, up to and including complete replacement of the cabinet, when in the Owner's determination the safety of the traveling public is best served. Such repair work will not in any way void or limit the vendor's warranty and guarantee specified above. The Owner will notify the vendor in writing of the repair. The vendor shall within five business days after notification replace, at Owner facilities, all cabinets, equipment, and supplies used by the Owner in making repairs, with new parts meeting the requirements of this specification.

Vendor shall be available by phone or email within one (1) hour during business hours or eight (8) hours outside of business hours, 24 hours per day, 365 days per year.

Vendor shall be able to provide assistance for all cabinet-related malfunctions including, but not limited to, cabinet construction, cabinet wiring, and interaction between cabinet and internal components including signal controller, MMU, vehicle detection system, or pedestrian detection system.

Miscellaneous:

Provide and install all required new wiring, harnesses, etc. needed to make the intersection EVP detectors and indicator lights operational to the satisfaction of the Engineer.

Install, complete all cabinet programming and pluggable installation work, and turn on and make operational each traffic signal cabinet complete with actuated controller unit and all required signal control equipment described above; provide and install all additional materials required to provide a complete operating traffic signal cabinet installation (which includes, but are not limited to: bonding and grounding materials; electrical equipment, harnesses, and panels; etc.). at each intersection as applicable; install all pluggables and make all field lead connections in the

traffic signal cabinet as directed by the Engineer, and provide all cabinet wiring diagrams, to make each new traffic control signal system operational.

The Contractor is responsible for all labor, materials, and controller cabinet support (**assume that at least one full day of support from cabinet supplier is included in the bid for the work at each signal system**) necessary to make the controller and cabinet operational to the satisfaction of the Engineer.

The Contractor is responsible for all testing of the conflict monitor for each new signal system. The Engineer must be present during testing, so that equipment operation can be verified at that time. The Engineer may need to coordinate having City police on-site at that time (to control traffic as needed), so provide at least 48-hour notice to the Engineer prior to completing testing work on the conflict monitor at each signal system.

The Engineer will provide the timing information for each controller unit to the Contractor, and the Contractor is responsible for providing all services necessary to have these timings entered into each controller unit to allow for the new signal systems to be placed into operation by the Contractor, to the satisfaction of the Engineer.

Contractor responsibilities as part of making each new controller and cabinet operational also includes the following work items:

- Providing and installing any necessary panels, jumpers, or harnesses in the controller cabinet to make the EVP system operational;
- Testing the operation of the EVP system in the presence of City personnel prior to acceptance of this work by the City;
- Completing all connections and jumper wiring in the controller cabinet;
- Verifying that all signal equipment is operational to the satisfaction of the Engineer;
- Completing all labeling of cables at all terminal strips as directed by the Engineer, and
- Labeling all applicable cables, conductors, racks, etc. as necessary using a permanent labeling device (handwriting of labels is NOT acceptable).

Providing, installing, and making operational a new traffic signal cabinet complete with all controller cabinet equipment as described above at each new permanent signal system will be included as part of the pay item for Item No. 2565 (TRAFFIC CONTROL SIGNAL SYSTEMS A-B), with no direct compensation being made therefore.

BB Traffic Control Signal Mast Arm Poles, Mast Arms, Luminaire Extensions, and Luminaires

Provide and install all mast arm poles, mast arms, luminaire extensions, street light davit arms and luminaires; all where noted in the Plans in accordance with the provisions of MnDOT 2565.2K, MnDOT 3831, and the most recent MnDOT Standard Plate Nos. 8121, 8123, and 8126 (included in the Plans).

1. LED Roadway Luminaires and Davit Arms

   Provide and install City approved LED Roadway Luminaires as specified herein and in the Plans.

2. Seal Mast Arm Standard Access Covers

Seal all 76 mm x 27 mm (3-inch x 5-inch) vertical pole shaft and mast arm handholes with a clear 100% silicone sealant to ensure a moisture free seal between the access cover and the handhole opening.

3. Luminaire Wiring

Provide and install a wire holder that supports the luminaire cable/conductors within the end of the luminaire slipfitter near the connection point of the luminaire. Approved wire holders are listed on MnDOT Approved/Qualified Products List WEB site for Signals:

http://www.dot.state.mn.us/products/index.html

4. Transformer Bases

Do not attach any appurtenances (such as pedestrian push buttons, signs, etc.) to the transformer base that requires the drilling of holes in the base.

For the opening at the bottom of the transformer base on each mast arm pole standard, provide and install a rodent intrusion barrier to seal the opening between the concrete foundation and the mast arm pole standard transformer base (**do NOT use stainless steel woven wire cloth**).

Rodent intrusion barrier listed on MnDOT's Approved Products List for Signals shall be used instead of stainless steel woven wire cloth specified in MnDOT 2565.2CC for traffic signal pole transformer bases (MnDOT Standard Plate No. 8121).

SS-2.5 CONSTRUCTION REQUIREMENTS

A Service Connection

The City of Duluth is responsible for costs associated with the initial service connection and monthly electrical service at each signal system. Coordinate with the City of Duluth and the electric utility company to connect power to the service conductors for each traffic signal system. This Work to coordinate the power to the service conductors and establish electrical service includes the following:

(1) Correctly filling out, completing, and submitting the electric utility company's application(s) for service connection and electrical service using the billing addresses to be provided by the City of Duluth at or before the Pre-Construction Meeting.
(2) Submitting a copy of the completed application(s) to the Engineer and the City of Duluth to ensure the correct agency is listed for paying the initial service connection invoice and the monthly electrical service invoices thereafter
(3) Notifying the Engineer and the City of Duluth once the electrical service has been established
(4) Providing a point of contact for the electric utility company during the Project

Ensure that the City of Duluth is filled out on the service connection application as the "applicant" for the utility (traffic signal system) responsible for paying electrical service invoices.

B Submittals

Provide submittals in accordance with MnDOT Spec. 2545.3A "Submittals", and the following.

B.1 Signal and Lighting Certification Submittal

Before the Work begins, submit copies of unexpired Department Signal and Lighting Certification Cards or evidence of valid Department Signal and Lighting Certification for persons on the Project Site performing and directly supervising the Work in accordance with MnDOT Spec. 2545.1A, "Qualifications of Workers" and include it as part of the submittals in accordance with MnDOT Spec. 2545.3A "Submittals".

Department Signal and Lighting Certified persons does not relieve the Contractor's responsibility to provide qualified workers performing electrical Work in accordance with Minnesota Statute 326B.33 "Licenses", and MnDOT Spec. 1802 "Qualifications of Workers".

C Fiber Reinforcement for Cabinet Equipment Pads

Provide fiber reinforced concrete mix 3G52-FRC for equipment pads in accordance with MnDOT 2461 "Structural Concrete". Use approved non-metallic fibers listed on MnDOT's APL-Concrete and ensure fibers are dispersed uniformly throughout the concrete mix by using one of the following listed methods:

(1) Open bag and distribute fibers on Aggregate belt at the Ready-mix Concrete plant
(2) Open bag, break apart any fiber clumps, and introduce fibers into the Ready-mix Concrete truck in a well-distributed manner
(3) Other methods to distribute fibers may be used if submitted to the Engineer for approval, following a demonstration of the method by successful trial placement before performing the Work

Tossing water-soluble bags of fiber into the Ready-mix Concrete trucks for the bag to dissolve on its own and the fibers to disperse is not a MnDOT approved method. Mixes employing this method of fiber distribution will not be allowed to use on the Project.

Balling that occurs at more than one location within 20 cubic yards of mix is considered failed placement and will not be approved for use. Balling of fibers is defined as a 2-inch diameter or greater conglomerate of fibers at the point of placement.

Ensure the manufacturer's technical representative is available by phone or in person to troubleshoot fiber inclusion into the mix during placement.

D Equipment Pad Excavation and Subbase

Excavate an area and provide a subbase layer that extends beyond each side of the equipment pad at least 6 inches. Provide a 6 inch thick compacted subbase layer.

Use an approved Aggregate Material in accordance with Virgin Granular and Aggregate Material for Foundations and Equipment Pads in the Materials section of these Special Provisions for the subbase layer.

E Cast In Place (CIP) Concrete Curing

Ensure CIP concrete meets the minimum curing period in accordance with MnDOT 2401.3 G.1 "Minimum Curing Period",

For installation of adhesive anchoring systems in concrete ensure concrete cure time is a minimum of 14 days.

F Conduit Buried in Aggregate Material and Concrete Encased Conduit

MnDOT 2565.3D.5.c "Conduit Encasement" is deleted and replaced with the following.

F.1 Conduit Buried in Existing Aggregate Material

When required to trench rigid PVC conduit in existing aggregate material, provide and install a trench bedding with a minimum 4 inches thick of granular material in accordance with MnDOT 3149.2G "Aggregate Bedding". Once the fine filter aggregate bedding has been installed, place the conduit in the trench on top of the bedding. Place a minimum 4 inches of Aggregate Material in accordance with Virgin Granular and Aggregate Material for Foundations and Equipment Pads in the Materials section of these Special Provisions over the top of the conduit before backfilling and compacting the trench.

F.2 Concrete Encased Conduit in the Ground

When ground conditions prevent compliance with the NEC conduit depths, provide a concrete covering or encasement in accordance with NFPA 70 National Electrical Code Handbook, Article 300.5 Use mix No. 3G52 concrete for the covering or encasement. Obtain Engineer's approval before performing the Work.

G Splices

2565.3I.3 "Splices" is deleted and replaced with the following.

G.1 Traffic Signal System Cables and Conductors

Splicing of traffic signal control cables and other cables used in the traffic control signal system are not allowed unless otherwise specified on the Plans. Install signal cables from the termination points in the traffic signal control cabinet to the field devices without splices in the cables.

G.2 Underground Cables

Do not splice underground cables unless specified in the Contract. If specified in the Contract to splice use an approved epoxy splice kit for underground splices listed on MnDOT's APL-Signals.

H High Strength Fasteners (Bolts) and Structural Bolting

Erect and assemble mast arms to traffic signal poles (posts or shafts) and transformer bases to traffic signal poles (post or shaft) and tighten fasteners using fixed sized wrenches and calibrated torque wrenches. Do not use impact wrenches, pipe wrenches, adjustable wrenches, or tongue-and-grooved pliers for tightening fasteners.

Anchor rods are not bolts. For tightening anchor rods refer to anchor rod tightening requirements in Contract Documents.

H.1 Transformer Base Structural Bolting

Fasten the pole to transformer base using the required high strength fasteners in accordance with MnDOT 2402 "Steel Bridge Construction", and as shown in Figure 1 "Pole to Transformer Base Bolting". Do not install lock washers.

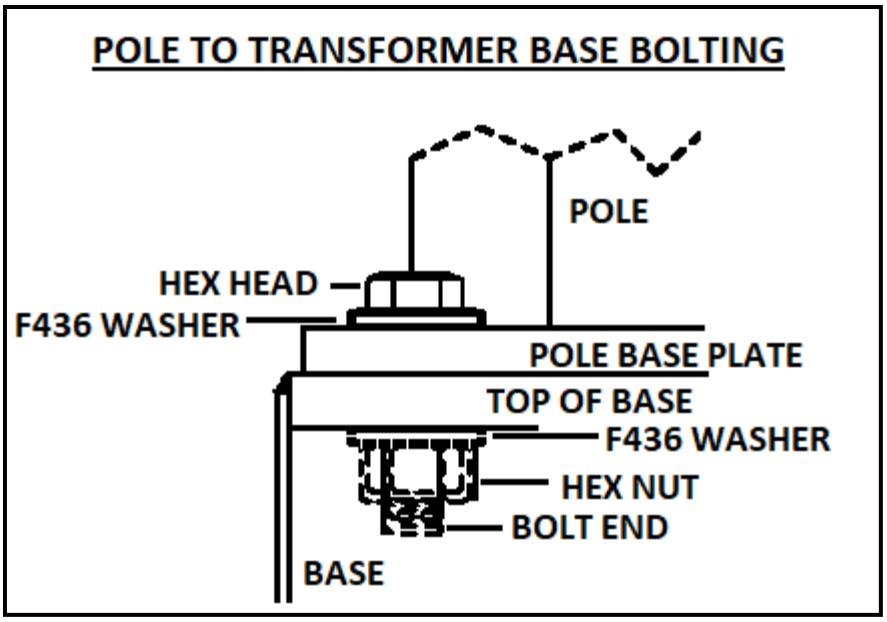


Figure 1: Pole to Transformer Base Bolting

Store and use fasteners in accordance with MnDOT 2402B.2 “High Strength Fasteners”. Remove fasteners from sealed, waterproof containers as required and before installing ensure there is lubricant on the fasteners and the condition of the fasteners has not changed due to weathering or other reasons. If there is no lubricant on the fasteners then apply an approved lubricant to the threads of the bolts, and the face of the hex nuts, hex heads, and washers that turn into each other.

Using an approved calibrated torque wrench listed on MnDOT’s APL, tighten each of the 1 ¾ inch A354 high strength bolts to a torque value of 2,500 foot pounds in the following order:

1) 20 percent (500 foot pounds) in a cross tightening pattern
2) 60 percent (1,500 foot pounds) in a cross tightening pattern
3) 100 percent (2,500 foot pounds) in a cross tightening pattern
4) Allow to relax for 10 minutes
5) Re-tighten to 100 percent torque value (2,500 foot pounds) in a cross tightening pattern

H.2 Mast Arm Structural Bolting

Fasten mast arms to poles using the required high strength fasteners in accordance with MnDOT 2402 “Steel Bridge Construction”, and as shown in Figure 2 “Mast Arm Bolting”. Do not install lock washers.

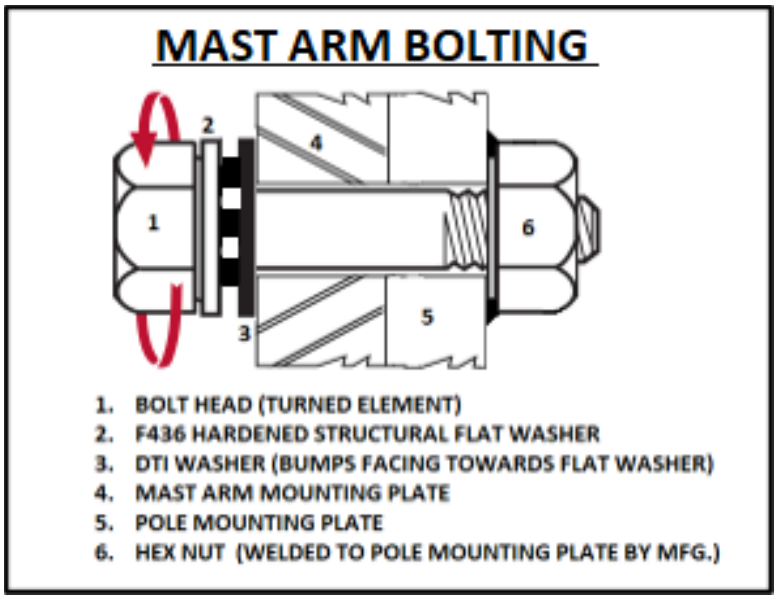


Figure 2: Mast Arm Bolting

I Storing Materials

Store and handle materials in accordance with MnDOT 1606 "Storage of Materials", MnDOT 1607 "Handling Materials" and the manufacturer's requirements.

~~**J Installation of City Provided Materials**~~

~~Install the City provided traffic control signal cabinets each complete with actuated controller unit and the required traffic control signal equipment.~~

~~Provide and install additional materials and equipment for a complete operating traffic control signal cabinet installation, including:~~

(1) ~~A cabinet concrete foundation using Contractor provided anchor rods, nuts, and washers.~~
(2) ~~Bonding and grounding materials and connections~~
(3) ~~Terminating field conductor connections in each traffic control signal cabinet as directed by the Engineer to make each traffic control signal system fully operational~~

~~**K Pick Up City Provided Materials**~~

~~Pick up materials and equipment described at the City of Duluth's signal shop (1532 West Michigan Street, Duluth MN 55806). Follow these requirements:~~

(1) ~~Request from the City the materials and electrical equipment~~
(2) ~~Request City provided materials at least 30 Business Days in advance of needing the material on the Project~~
(3) ~~Notify the City at least 3 Business Days in advance of intention to pick up materials and electrical equipment. Contact Duncan Schwensohn at 218-730-5107.~~
(4) ~~Pick up the City provided materials and electrical equipment at the specified location and transport them to the job sites~~
(5) ~~Secure each cabinet in an upright position when transporting to the job sites. Ensure that each cabinet being transported will not tip and be damaged.~~

L Video Detection

Install and make operational all video detection devices at the locations shown on the Plan and as follows:

1. Provide and install all cables, conductors, mounting hardware, and all other equipment necessary to make operational each video detection device as per the Plans and to the satisfaction of the Engineer.

2. All equipment necessary in each controller cabinet to operate the new video detection systems shall be provided and installed by the Contractor, and shall be new and fully compatible with the "Autoscope Vision" or Engineer approved equal cameras.

3. Affix to the back of each video detection camera a permanent label indicating the date of installation.

4. The video cable shall be Autoscope Branch Cable. The cable is comprised of power limited tray cable as follows: 3 conductor are #18 AWG (19X#30) extruded polyethylene insulation, overall Polyethylene jacket with nylon ripcord and color coded or approved equal by the Engineer. Install continuous un-spliced cable between the cabinet and each video detection camera.

5. Install the Autoscope cameras at the location as shown in the plans and directed by the Engineer, in accordance with the manufacturer's guidelines. Autoscope camera locations and corresponding cable shall be labeled to correlate with labels shown in the Plan.

6. Drip loops shall be provided for the camera power and video cables using a 3/4-inch strain relief fitting.

7. The cameras shall be aimed and secured in an aimed position by the Contractor. Aim each camera for optimal field of view and detector placement at each specific approach. The Contractor shall employ an Autoscope supplier approved Field Service representative to perform the video system configuration and program video image detection zones as shown on the Plan. Verify that live video images show the detection zones properly overlaid and operating, and detection zones are working correctly.

8. All Autoscope equipment and cameras shall be installed by personnel with proper training and certified for Autoscope installation by the equipment manufacturer.

9. The Contractor is responsible for all the cost including services of field service representative of the Autoscope supplier.

M Maintenance and Operation of New and Existing Traffic Control Signal Systems

Specification heading and language for MnDOT Spec. 2565.3B, "Maintenance and Operation of New and Existing Electrical Systems", are deleted and replaced with the heading "Maintenance and Operation of New and Existing Traffic Control Signal Systems", and as follows:

This Work consists of maintaining, operating, and locating new and existing traffic control signal systems in accordance with MnDOT 2565.1A and the following:

M.1 Maintain and Keep in Operation New and Existing Traffic Control Signal Systems

Maintain and keep in operation the new and existing Traffic Control Signal Systems within the limits of the Project in accordance with MnDOT 1514, "Maintenance During

Construction," but not including MnDOT 1404.6, "Traffic Control During and After Winter Suspension," until the Engineer accepts the Project in writing as specified in MnDOT 1716, "Contractor's Responsibility for Work." Maintain and keep in operation new and existing Traffic Control Signals during periods of suspension at no additional cost to the City of Duluth.

Before an authorized Work suspension begins, ensure existing, temporary, and new traffic control signal systems are in full working order in accordance with the Contract. Maintenance and operations of traffic control signal systems will not be suspended until the following requirements have been met:

(1) Notify the City of Duluth of Work suspension start and stop dates
(2) Remedy electrical Work deemed unsafe by the Engineer
(3) Schedule and provide a walk through with the City of Duluth
(4) Cover and clearly mark above ground splices not protected by a structure
(5) Ensure electrical components and devices are in working order
(6) Submit to the Engineer a current As-Built redlined drawing of the electrical systems (existing, temporary, and new)

Due to the nature of electrical systems, Partial Acceptance will not be granted because of an authorized Work suspension unless the new traffic control signal system Work has been completed and inspected in accordance with the Contract and the new system is fully operational.

When resuming Work after authorized Work suspension, remove temporary construction or Materials that the City used to maintain the traffic control signal system during the suspension.

Notify the Engineer at least 48 hours before scheduled turn-offs and before performing Work on Traffic Control Signals. Do not turn off existing Traffic Control Signal systems without the Engineer's approval and the Engineer's presence.

If damage to new or existing Traffic Control Signals occurs due to Contractor operations, within 24 hours repair or replace the damage at no additional cost to the City in accordance with MnDOT 1716, "Contractor's Responsibility for Work," and relevant to Specifications for new construction. Failure to repair or replace damage within 24 hours will result in the City repairing or replacing and deducting costs from Project money entitled to the Contractor.

The City will maintain the existing Traffic Control Signal cabinets and control Equipment within the cabinet unless otherwise specified in the Contract.

This Work is considered Work included in the Pay Item for Traffic Control Signal Systems A and C and for Revise Signal System B, except if the Engineer directs, or the Contract requires turn-offs.

M.2 Locate Underground Facilities

Locate underground facilities of existing traffic control signal systems including temporary, and newly constructed signal systems within the limits of the Project, for the duration of the construction project in accordance with the applicable provisions of MnDOT 1514 and in accordance with Minnesota State Statute 216D.

Responsibility for locating underground traffic control signal system facilities is transferred from the City to the Contractor on the Project start date as shown on the Proposal.

Request at the start of the Project for the City's locating group to provide an initial locate of the underground traffic control signal system facilities within the project limits. Submit initial locate requests to the City's Locating Office a minimum of four Business Days before the Project start date.

Locate requests that are within the construction Project limits will continue to be received by the City's Locating Office. These locate tickets will be forwarded to the Contractor's representative responsible for coordinating locate requests within the project limits. The locate tickets will be forwarded via email. Confirm receipt of the locate ticket by notifying the City's locating office within two hours of the City sending the locate request.

Repair traffic control signal system facilities damaged as the result of improperly located or unmarked underground traffic control signal system facilities within the project limits.

Repair the damaged underground traffic control signal system facilities in accordance with "Maintain and Keep in Operation New and Existing Traffic Control Signal Systems" in this section of these Special Provisions.

During periods of authorized Work suspension, the City will perform GSOC locate requests on the Project in accordance with MnDOT 1514 "Maintenance During Construction" only if the listed requirements before an authorized work suspension begins in the "Maintain and Keep in Operation New and Existing Traffic Control Signal Systems" section have been met.

This Work is included in the Unit Prices of the Pay Items that are part of the Traffic Control Signal Systems A and C, and Revise Signal System B pay items.

Notify the City's Locating Office to provide contact information and establish assumed responsibility for locating the City's underground traffic control signal system facilities within the Project. Fill out the form in this section and submit to the Engineer at the pre-construction meeting.

Until final written acceptance of the project by the Engineer (MnDOT 1716) locate underground traffic control signal facilities as required above.

N Locating Responsibility Form

A version of this excel spreadsheet form can be downloaded here.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=27303373

Locating Responsibility Form	
Job S.P. Number	
Job Type	
Start Date	
End Date	
T.H.	
Location	
Lighting/ Signal Inspector	
Contractor	
Contractor (24 Hour Contact)	
Project Manager	
Phone Number	
Fax Number	
Email	
Electrician	
Phone Number	
Locator Area	
Project Engineer	
Phone Number	
Chief Inspector	
Phone Number	
Weekly Meeting	

O Traffic Signal Mast Arm Pole Installation

Install traffic signal mast arm poles in accordance with MnDOT 2565.3O "Traffic Signal Mast Arm Pole Installation", and the following.

If equipment downtime is a concern for meeting completion of the pole installation process in accordance with MnDOT 2545.3H "Pole Installation", then provide at least two crews; one crew to stand the pole and the other crew to complete the anchor rod tightening procedure in accordance with the Contract Documents on the same day of standing the pole.

Erect structural steel members in a manner that will provide safety to workers, Inspectors, the public, and without damaging the steel members.

P Anchor Rod Tightening Plan

Schedule a time agreed upon with the Engineer to present an anchor rod tightening plan by the Contractor's personnel installing the poles specified on the Project and in the presence of the Engineer or Inspector.

This specification ensures all parties are familiar with anchor rod tightening requirements, including the following for the specified poles installed on the project:

(1) An understanding of the steps in the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures"
(2) Knowing where and when to apply lubrication on anchor rod joints
(3) Using the required hardware and the installing in the correct order
(4) Applying the correct torque values, torque tightening steps, and cross tightening pattern
(5) Confirming wrenches and equipment used are calibrated and can perform adequately

Sign and date the "Sign-Off Sheet" document included on a separate page in these Special Provisions and submit to the Engineer or Inspector for their signature that they observed the Contractor's anchor rod tightening plan and determined that the Contractor performing the anchor rod tightening understands the anchor rod tightening requirements in accordance with the Contract. Submit the completed "Sign-Off Sheet" document to the Engineer before installing poles on the Project.

The "Sign-Off Sheet" document can also be downloaded using the following the link:

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=34706201

SIGN-OFF SHEET

For Anchor Rod Tightening Demonstration

This Sign-Off Sheet affirms the Contractor providing the anchor rod tightening has demonstrated to the Engineer or Inspector an understanding and competency in performing anchor rod tightening in accordance with the Contract.

Contractor Rep. Signature: _____

Date: _____

Engineer or Inspector Signature: _____

Date: _____

Q Traffic Signal Mast Arm Pole Anchor Rod Tightening

Tighten traffic signal mast arm pole anchor rods in accordance with the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures" and the MnDOT Anchor Rod Tightening Form titled "MnDOT ANCHOR ROD TIGHTENING FORM- STAINLESS STEEL AND COATED STEEL POLES". Perform the anchor rod tightening in the presence of the Engineer or Inspector.

Use a required torque wrench listed on MnDOT's APL-Signals on the top nuts to tighten anchor rods to the required torque values specified in the MnDOT Anchor Rod Tightening Handbook. Submit calibration certification in accordance with MnDOT 2565.3A.13 "Calibration Requirements for Measurement Tools and Test Equipment" of the torque wrenches and measurement equipment intended to be used for anchor rod tightening no more than two weeks in advance.

Complete the MnDOT Anchor Rod Tightening Form using one of the following options:

(1) Screen-fillable PDF form – "fillable" on a computer (Adobe Acrobat Reader required)
(2) Blank screen-fillable PDF form downloaded and printed hard copies to fill out by hand (Adobe Acrobat Reader required)
(3) Hard copy of a blank screen fillable form included in this section on a separate page and to make additional copies as needed to fill out by hand

If using option (1) or (2), then download the form using the following link:

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=30927235

It is recommended to click on the link, open file, and save as to save the form on the computer hard drive. Then use the screen fillable form option (1) or the printed hard copy blank screen-fillable form option (2) in Adobe Acrobat Reader independently from the browser or internet connection.

Fill out the anchor rod tightening forms at the time of installation for each traffic signal mast arm pole. Each form requires a signature from the contractor's employee performing the anchor rod tightening and the date of pole installation on the signature block at the bottom of the form. If using the screen-fillable PDF form option (1), then an electronic signature may be used, or the completed form can be printed with a handwritten signature. Submit the completed forms to the Engineer. If using option (1), the completed forms may be submitted electronically upon approval of the Engineer or in printed hard copies.

DEPARTMENT OF TRANSPORTATION

MnDOT ANCHOR ROD TIGHTENING FORM – STAINLESS STEEL AND COATED STEEL POLES

Directions: Use the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures" with this form when installing stainless steel and coated steel traffic signal and light poles using a double-nut connection. Select "N/A" for specified questions if the question does not apply. Select "YES" or "NO" for response to the following questions in each step.

Date_____ Project No_____ Pole Type_____ Pole No_____

Contractor_____ Contractor REP. _____ Inspector_____ Wrench calibration cert. date_____

1. **Verify the installation**	Followed Step 1 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Used special washers when required by the pole manufacturer or as specified in contract documents? ☐ N/A	☐ YES ☐ NO
2. **Level the leveling nuts and place pole**	Followed Step 2 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Used pole manufacturer's standoff distance when required? ☐ N/A	☐ YES ☐ NO
3. **Lubricate**	Followed Step 3 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Lubricant applied only to the areas shown in the "Lubrication Areas" section in the Handbook?	☐ YES ☐ NO
4. **Hand tighten top nuts and wrench tighten leveling nuts in a cross-tightening pattern**	Followed Step 4 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Used cross-tightening pattern when tightening? Used specified wrench length on Table 1-3 for tightening leveling nuts?	☐ YES ☐ NO
5. **Torque top nuts in cycles (STEPS) as specified**	Followed Step 5 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Used cross-tightening pattern for each of the torque value cycles of 20%, 60%, and 100%?	☐ YES ☐ NO
6. **Allow rods to relax for 10 minutes**	Followed Step 6 in the Anchor Rod Tightening Handbook "New Installation Procedures"?		☐ YES ☐ NO
7. **Re-tighten to 100% torque**	Followed Step 7 in the Anchor Rod Tightening Handbook "New Installation Procedures"?		☐ YES ☐ NO

Signature _____ Date_____

The following hyperlink is for the MnDOT Anchor Rod Tightening Handbook

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=11138998

R Single Nut Connection Installation for Traffic Signal Structures

Install APS Push Button Stations with the Pedestrian Push Button Bases in accordance with the manufacturer's installation requirements and the following.

Structure bases requiring single-nut anchor rod connections are set directly on the foundation without leveling nuts. One hex nut for each anchor rod is used to fasten the base to the foundation anchor rods. Use washers in the connections in accordance with the manufacturer's installation instructions and Contract Documents.

Use leveling shims provided and recommended by the base manufacturer when required to level the pole base on the foundation. If the manufacturer does not provide leveling shims, then use leveling shims in accordance with MnDOT Standard Plate No. 8129. To prevent excessive shim use, install no more than three shims per base corner and no more than six shims total per base. If more shims are needed to plumb the pole, then reinstall the foundations level and plumb as specified in Contract Documents. Do not use washers, spacers, or nuts to level poles. Fill gaps that exceed 1/8 inch between the foundation and the pole base with 100 percent clear silicone sealant. Do not completely seal around the perimeter between the foundation and the pole base.

Use torque wrenches to tighten the nuts on anchor rods to the required torque values specified.

Submit calibration certification in accordance with MnDOT 2565.3A.13 "Calibration Requirements for Measurement Tools and Test Equipment" of the torque wrenches and measurement equipment intended to be used for anchor rod tightening no more than two weeks in advance.

Traffic signal structures that require single nut connection installation includes the following:

(1) Four inch diameter straight Pedestal Pole and Pedestal Base
(2) APS Push Button Station with Pedestrian Push Button Base
(3) Signal Head Pedestal Pole with Transformer Base

Perform the required anchor rod tightening in the presence of the Engineer or Inspector. Tighten anchor rods for single nut connections to the required total torque value as specified by the base manufacturer and divide it into three passes of 20%, 60%, and 100% of that required total torque value as specified in the MnDOT Anchor Rod Tightening Form. If the base manufacturer does not specify a required total torque value, then use the torque values as shown in Table SS-2.3-2. Tighten anchor rods in accordance with the base manufacturer, the Contract Documents, and the MnDOT Anchor Rod Tightening Form titled "*MnDOT ANCHOR ROD TIGHTENING FORM-ALUMINUM POLES (Signal Pedestal and Light Poles)* included in this section.

Table SS-2.3-2
Required Torque Values (Ft-Lbs)
For Single Nut Connection Traffic Signal Structures

Base Type	Pass One 20 %	Pass Two 60 %	Pass Three 100 %	Re-Tighten 100 %
APS Push Button Station Base	12	36	60	60
Pedestal Pole and Pedestal Base with ¾" Diameter Anchor Rods	18	54	90	90
Pedestal Pole and Pedestal Base with 1" Diameter Anchor Rods	30	90	150	150
Signal Head Pedestal Pole and T- Base with 1" Diameter Anchor Rods	30	90	150	150

Follow the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures" only when instructed to on the MnDOT Anchor Rod Tightening Form titled "MnDOT ANCHOR ROD TIGHTENING FORM-ALUMINUM POLES (Signal Pedestal and Light Poles)". Signal Pedestal Poles includes poles listed in this section "Single Nut Connection Installation for Traffic Signal Structures". To obtain the MnDOT Anchor Rod Tightening Handbook use the following hyperlink.

MnDOT Anchor Rod Tightening Handbook (pdf)

Complete the MnDOT Anchor Rod Tightening Form using one of the following options:

(1) Screen-fillable PDF form – "fillable" on a computer (Adobe Acrobat Reader required)
(2) Blank screen-fillable PDF form downloaded and printed hard copies to fill out by hand (Adobe Acrobat Reader required)
(3) Hard copy of a blank screen fillable form included in this section on a separate page and to make additional copies as needed to fill out by hand

If using option (1) or (2), then download the form using the following link:

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=30927075

It is recommended to click on the link, open file, and save as to save the form on the computer hard drive. Then use the screen fillable form option (1) or the printed hard copy blank screen-fillable form option (2) in Adobe Acrobat Reader independently from the browser or internet connection.

Fill out the anchor rod tightening forms at the time of installation for each pole. Each form requires a signature from the contractor's employee performing the anchor rod tightening and the date of pole installation on the signature block at the bottom of the form. If using the screen-fillable PDF form

option (1), then an electronic signature may be used, or the completed form can be printed with a handwritten signature. Submit the completed forms to the Engineer. If using option (1), the completed forms may be submitted electronically upon approval of the Engineer or in printed hard copies.

DEPARTMENT OF TRANSPORTATION

MnDOT ANCHOR ROD TIGHTENING FORM – ALUMINUM POLES (Signal Pedestal and Light Poles)

Directions: Complete this form when installing aluminum traffic signal pedestal and light poles using a single-nut connection. Follow the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures" steps only when directed on this form. Select "N/A" for specified questions if the question does not apply. Select "YES" or "NO" for response to the following questions in each step.

Date_____	Project No_____	Pole Type_____	Pole No_____
Contractor_____ _____	Contractor REP. _____ _____	Inspector_____ _____	Wrench calibration cert. date_____

1. **Verify the installation Follow Step 1 in Handbook**	Followed Step 1 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Used special washers when required by the pole manufacturer or as specified in contract documents? ☐ **N/A**	☐ **YES** ☐ **NO**
2. **Place pole and base on foundation, install washers, and level using shims**	*Do not apply lubricant in this step	Used no more than three leveling shims per base corner and no more than six shims total per base?	☐ **YES** ☐ **NO**
3. **Lubricate Follow Step 3 in Handbook**	Followed Step 3 in the Anchor Rod Tightening Handbook "New Installation Procedures"?	Lubricant applied only to the areas shown in the "Lubrication Areas" section in the Handbook?	☐ **YES** ☐ **NO**
4. **Hand tighten top nuts in a cross-tightening pattern**	Used cross-tightening pattern when hand tightening?		☐ **YES** ☐ **NO**
5. **Tighten top nuts to the required torque values in accordance with contract documents, in three cycles (steps) as specified in Step 5 of the Handbook**	Followed Step 5 in the Anchor Rod Tightening Handbook "New Installation Procedures" and used torque values for aluminum bases as specified in the contract	Used cross-tightening pattern for each of the torque value cycles of 20%, 60%, and 100%?	☐ **YES** ☐ **NO**
6. **Allow rods to relax for 10 minutes Follow Step 6 in Handbook**	Followed Step 6 in the Anchor Rod Tightening Handbook "New Installation Procedures"?		☐ **YES** ☐ **NO**
7. **Re-tighten to 100% torque Follow Step 7 in Handbook**	Followed Step 7 in the Anchor Rod Tightening Handbook "New Installation Procedures"?		☐ **YES** ☐ **NO**

Signature _____ Date_____

S Compliance with NEC Article 110. 24

Provide fault current calculations in accordance with MnDOT 2565.3Z and as follows:

Fill out the following electric service information form shown below for traffic control signal systems.

Provide to the Engineer, before final acceptance of the project, a copy of the electric service information form for traffic control signal systems.

The Contractor provided "electrical service information form for traffic control signal systems" and available fault current calculations and labeling are included in the Unit Prices of the Pay Items that are part of the Traffic Control Signal System A and B pay items.

The form below can be downloaded by following the link.

https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=28764647

Electric Service Information Form For Traffic Control Signal Systems

Project Number: **Contractor:**

Date:

MN/DOT Signal System ID	Intersection	Meter Address	Transformer Primary Fuse Size and Type	Electric Utility Transformer Size In KVA	Transformer Internal Impedance Z in Percent	Transformer Secondary Voltage Line to Line and Line to Neutral	Size of Conductors In American Wire Gauge (AWG)	Length of conductors in feet from transformer connection to meter socket connection.			Calculated Available Fault Current at the line Side of the Meter Socket	Service Cabinet Main Circuit Breaker Size in AMPS
								L1 =	L2 =	Neutral		
								L1 =	L2 =	Neutral		
								L1 =	L2 =	Neutral		
								L1 =	L2 =	Neutral		
								L1 =	L2 =	Neutral		

NEC Article 110.24

T Signal Pole Foundations

Signal pole foundations should be drilled using an auger. If any excavation is done instead, the work shall be kept within the construction limits and right-of-way shown, and any temporary shoring required to do so is included in the Traffic Control Signal System A and B pay items.

U Handholes

Install handholes as required by the Contract and as approved by the City of Duluth. The Contractor may install additional handholes at no additional cost to the City. All handholes shall be centered into concrete slab with control joints no closer than 18 inches from any edge. Replace existing sidewalk/pavement in kind.

Set the tops of handholes so the cover is 1 in below grade, except in sidewalk areas, set the cover flush, or as directed by the Engineer.

To facilitate drainage, set handholes on a compacted aggregate drain bed, 4 feet in diameter or square, and 12 inches deep, using coarse filter aggregate in accordance with MnDOT 3149.2H, "Coarse Filter Aggregate."

Backfill handholes after installing the cover.

Drill conduit holes into the side walls of handholes no more than 1 inch larger than the size conduit being installed.

Conduits entering handholes must enter thru the barrel or side wall of the handhole.

After handhole and conduit installation at each handhole location, make the sidewalls inside handholes watertight by patching with concrete for pre-cast concrete handholes, or material-compatible caulking compound, or other sealing material, compatible handhole material, to the Engineer's satisfaction.

For placing pre-cast concrete handholes with Type HD or other metal frame and cover, in areas not surfaced with concrete, support handholes with concrete to the City of Duluth's satisfaction.

V Activating Signals

Notify the Engineer at least one week before each scheduled traffic control signal activation. Traffic control signal system turn-on shall not be scheduled on Fridays or before a holiday.

W Temporary Signal Construction, Staging, and Operations

This work consists of the following:

- Salvaging and installing in-place traffic signal components, providing and installing materials and electrical equipment as specified herein;
- Removing and salvaging temporary signal system materials and electrical equipment after the new permanent signal system is placed into operation;
- Providing all labor and materials necessary to revise the temporary signal systems during each stage of construction;

all to provide temporary signal system operation during intersection and signal system reconstruction, in accordance with the applicable provisions of MnDOT 2565; with the Plans; and as follows.

- TEMPORARY SIGNAL SYSTEM "A" – at the intersection of Railroad Street and Canal Park Drive/North Lake Avenue, and

- TEMPORARY SIGNAL SYSTEM "B" – at the intersection of Railroad Street and South Lake Avenue/Lake Place Drive.

General

1. All applicable provisions of the current edition of the National Electrical Code apply.

2. All materials and electrical equipment provided by the Contractor for each temporary signal system (hardware and bracketing, etc.) must be approved by the Engineer prior to installation. No installation work can begin until signal materials are approved for installation by the Engineer.

3. Ensure that a traffic control signal system is kept in operation at each intersection at all times. Do not turn-off a traffic control signal system without the specific approval of, and only in the presence of, the Engineer and the City. Notify the Engineer and the City at least 48 hours in advance of scheduled turn-offs and before performing work on a traffic control signal system.

4. The Contractor is responsible for maintaining operation of each temporary signal system during all stages of construction.

5. Any change initiated by the Contractor resulting in an increase in materials, quantities, or in work will be considered incidental to the pay items for "TEMPORARY SIGNAL SYSTEMS A-B" and no direct compensation will be made therefore.

6. Except during any periods of authorized work suspension, the Contractor is responsible for all maintenance of every signal system item of each temporary traffic control signal system, except for the traffic signal cabinets and signal control equipment which will be maintained by the City (includes timing and complete maintenance of the cabinet and control equipment) until final written acceptance of the project by the Engineer (MnDOT 1716).

7. During any periods of authorized work suspension, the City will provide and maintain the traffic signal cabinets and control equipment and will maintain each temporary traffic control signal system.

8. Provide to the City the names and phone numbers of contact personnel for both day and night operation for each temporary signal system.

9. The City by their own forces will make all necessary revisions in each intersection traffic signal cabinet and control equipment when the transition from one stage of temporary signal system to another stage of temporary signal system occurs. For each stage of temporary signal system, the Contractor shall make all necessary field lead connections in each intersection traffic signal cabinet as directed by the Engineer and shall make each temporary signal system operational.

10. Cast Aluminum Pipe Fittings

    Cast aluminum pipe fittings are not permitted for mounting vehicle signal heads.

    All locknuts, nipples, lock nipples, gaskets, washers, and all other hardware, used to fasten vehicle signal heads to signal bracketing and pipe fittings and to signal head mounts must not be fabricated of aluminum.

Materials and Construction

1. Conduit

   Place a section of liquid tight flexible non-metallic conduit and conduit fittings in accordance with MnDOT 3804 from each metal junction box to each signal bracket.

   Use a weather head service entrance type fitting with knockouts (unused knockouts must not be opened) for conduits terminating near the top of wood poles.

2. Signal System Controller Cabinet Foundations

   Maintain each existing traffic signal controller cabinet and corresponding service equipment for each temporary signal system as noted in the Plans.

3. Service Equipment

   Protect, maintain, and make operational each existing signal service cabinet/equipment.

   Provide and install all other materials and equipment not covered above which are necessary to provide a complete operating signal service cabinet/equipment at each intersection.

4. Vehicle Signal Heads

   Provide new vehicle signal heads for wood pole and span wire mounting of signal heads where noted in the Plans. New vehicle signal heads shall be in accordance with MnDOT 3834 (with LED indications).

   Existing vehicular (and pedestrian) signal heads to be reused with each Temporary Signal System shall be maintained and made operational as noted in the Plans.

   Install each one-way span wire mounted vehicle signal head as detailed on the "TYPICAL WOOD POLE/SPAN WIRE SIGNAL SYSTEM DETAILS" in the Plan to the satisfaction of the Engineer.

5. Roadway Lighting on Wood Poles

   Provide mast arms and luminaires for roadway lighting in accordance with the following specifications:

   Mast arms for luminaires shall be suitable for wood pole mounting, be 15-feet in length, be galvanized, and have a nominal 2 3/8-inch diameter slipfitter for the luminaire.

   Provide City approved luminaires on wood poles (with photoelectric control) where shown on the Plans and on MnDOT's Approved/Qualified Products List for Lighting:

   http://www.dot.state.mn.us/products/index.html

   Provide a 1-3/C 14 AWG (LUM) signal control cable from the service cabinet/equipment circuit breakers to each luminaire as required by the Plans with a 2 A (1.5-inch X .406 inch) fast acting fiber tube cartridge fuse mounted in a watertight inline fuse connector in the ungrounded conductor and located inside each new luminaire housing. It is not required that the inline fuse connector be made of rubber.

6. Span Wires

Span wire shall be galvanized strand wire as approved by the Engineer.

7. Bonding and Grounding

Provide and complete all bonding and grounding in accordance with the National Electrical Code; with the Plans; and the applicable provisions of MnDOT 2565.3H, except as follows:

> Ensure that metal conduits, luminaire mast arm, metal junction boxes, span wire, down guys, service equipment, video detection units, and the traffic control signal cabinet are made mechanically and electrically secure to form a continuous bonded and grounded system. Provide a copper wire, not less than No. 6 AWG as the bonding jumper. Use material compatible grounding clamps and connectors to attach the bonding and grounding jumper to span wires, down guys, conduits, and the ground rod electrode.

8. Controller Cabinet

Maintain existing controllers and cabinets on existing concrete foundations for use with each Temporary Signal System.

Terminate all new cables and conductors as required in each in-place controller cabinet, provide and install all additional materials to provide a complete operating traffic signal system, and make all field lead connections in the cabinet as directed by the Engineer to make each temporary traffic control signal system operational.

Provide and install all other materials and equipment not covered above which are necessary to provide a complete operating temporary traffic control signal system at each intersection.

9. Video Detection

Provide, install, aim, and make operational City approved traffic signal high-definition video detection systems at the locations shown on the Plan and the following:

- Aim each camera for optimal field of view and detector placement at each specific approach,
- Provide and install continuous un-spliced video cable (meeting the requirements of the manufacturer of the video detection system),
- Zoom and focus the cameras to provide proper imaging of the approaches,
- Coordinate with the City to have video image detection zones programmed in the controller cabinet, and
- Verify with the City of Duluth:

  (a) Aim each camera for optimal field of view and detector placement at each specific approach,
  (b) Detection zones are working correctly, and
  (c) Live video images show the detection zones properly overlaid and operating.

- Remove, reinstall, and aim cameras for optimal field of view and proper detector overlay placement when different stages of the project require intersection configuration changes.

Provide and install all additional materials and electrical equipment to provide a complete operating video vehicular detection system installation at each intersection (which includes, but is not limited to: wood pole mounting brackets and hardware, detection cables and conductors (including drop loops if required); bonding and grounding materials and connections; etc.); and make all field lead connections and complete all set-up, aiming and testing as directed by the Engineer to make each video vehicular detection system operational.

Traffic Signal Staging

Construction of the temporary and permanent signal systems shall be accomplished according to the suggested staging detailed below unless an alternate plan, provided by the Contractor at no additional cost, is approved by the Engineer as part of the planned sequence of construction. However, the Contractor shall make sure that a traffic control signal is operational at each intersection at all times, except as approved by the Engineer.

Utilize the existing signals, permanent signals, or combinations thereof, to provide temporary operation of each traffic signal at each intersection, all to the satisfaction of the Engineer. Provide any necessary wires and cables and make all required connections to keep the existing signals, permanent signals, or combinations thereof, in operation at each intersection, all to the satisfaction of the Engineer.

Prior to beginning the signal construction, install all components necessary for temporary operation of each signal system.

When ready for temporary operation of each signal system, turn-on all temporary vehicular detection system components, and make each temporary signal system operational to the satisfaction of the Engineer.

During construction, the Contractor is responsible for adjusting and re-aiming vehicular detectors over the appropriate traffic lanes as directed by the Engineer. Adjusting and re-aiming vehicular detectors during construction will be considered as incidental to each Temporary Signal System.

Make all necessary field lead connections in each intersection traffic signal cabinet as direct by the Engineer and make each temporary signal system operational.

Upon completion of all road and signal construction, remove and salvage all items of each temporary signal system, complete all work on each new permanent signal system, and place each new permanent signal system into operation as shown in the Plans and as directed by the Engineer.

Removal of Temporary Signal Systems

When directed by the Engineer and in coordination with the roadway construction project, remove and salvage all materials and electrical equipment of each temporary traffic control signal system, as required by these Special Provisions, in accordance with the applicable provisions of MnDOT 2104, and as follows:

Remove temporary vehicular detection system components, electrical cables and conductors, signs, bracketing, hardware, and all other items supplied by the Contractor for each temporary traffic control signal system entirely and dispose of outside the right-of-way in any manner that the Contractor may elect subject to the provisions of MnDOT 2104.3C3.

All resulting excavation must be backfilled, and the backfilling and compaction shall be like in kind to approximately the same density as the adjoining ground. Any roadway surfacing (concrete pavement, bituminous surface, or gravel surface, including underlying base courses), sidewalks, curbs and gutter, sod,

etc., removed by the construction operations shall be replaced in kind by the Contractor, all at his own expense.

All removals of materials of each temporary signal system, the disposal of Contractor-owned materials, and backfilling, all in accordance with the foregoing, will be considered as incidental to Temporary Signal Systems "A-B" (Item No. 2565), with no direct compensation being made therefore.

SS-2.6 MEASUREMENT AND PAYMENT

A As Built Drawings and GPS Coordinates

As Built drawings and GPS coordinates in accordance with Division S Special Provisions "As-Builts" including Pay Item No. 2011.601 (AS BUILT).

B Method of Measurement

Removing items of the existing traffic control signal system; furnishing and installing materials and electrical equipment; ~~and installing City furnished materials~~ as specified, to provide two (2) complete operating traffic control signal systems at the locations noted in the Plans and as contained in these Special Provisions will be measured as an integral unit complete in place.

Providing, installing, making operational, maintaining, and removing all components of each temporary traffic signal system at the locations noted in the Plans and as contained in these Special Provisions will be measured as an integral unit complete in place.

C Basis of Payment

1. Providing and installing materials and electrical equipment ~~and installing City furnished materials~~ to provide for two (2) complete operating Traffic Control Signal Systems at the following locations:

    - System "A" – Railroad Street and Canal Park Drive/North Lake Avenue in Duluth, St. Louis County
    - System "B" – Railroad Street and South Lake Avenue/Lake Place Drive in Duluth, St. Louis County,

    as contained in these Special Provisions and as shown in the Plans will be paid for under Item No. 2565.516 (TRAFFIC CONTROL SIGNAL SYSTEM A) and Item No. 2565.516 (TRAFFIC CONTROL SIGNAL SYSTEM B) at the Contract price per SYSTEM.

2. Providing and installing materials, and electrical equipment; removing and salvaging these items after the new permanent signal system is placed into operation; and providing for all labor and materials necessary to maintain operation of the temporary traffic control signal system during each stage of construction, all to provide two (2) complete operating temporary traffic control signal systems at the intersections of Railroad Street with Canal Park Drive/North Lake Avenue (System A) and with South Lake Avenue/Lake Place Drive (System B), all in the City of Duluth, St. Louis County, as contained in these Special Provisions and in the Plans, will each be measured as an integral unit complete in-place and operational, and will be paid for under Item No. 2565.616 (TEMPORARY SIGNAL SYSTEM A) and Item No. 2565.616 (TEMPORARY SIGNAL SYSTEM B) at the contract price per SYSTEM, which price is compensation in full for all costs incidental thereto (including removal and salvaging of each temporary signal system after all work is completed).

SS-3 (2565) EMERGENCY VEHICLE PREEMPTION (EVP) SYSTEMS

SS-3.1 DESCRIPTION

This Work consists of providing and installing an emergency vehicle preemption (EVP) system at the intersections of:

- System "A" – Railroad Street and Canal Park Drive/North Lake Avenue in Duluth, St. Louis County, and
- System "B" – Railroad Street and South Lake Avenue/Lake Place Drive in Duluth, St. Louis County,

in accordance with MnDOT 2565 "Traffic Control Signals", the Plans, and the following.

SS-3.2 MATERIALS

A Contractor Provided Equipment

Provide Emitter Activated Emergency Vehicle Preemption (EVP) equipment in accordance with MnDOT 3814 "Emergency Vehicle Pre-emption (EVP) Equipment". Both optical EVP and Opticom (GTT) GPS EVP shall be used.

Phase selectors (or other EVP equipment to be installed in the traffic control signal cabinet) will be installed in the ~~City~~ CONTRACTOR provided controller cabinets by the Contractor.

Contractor provided equipment for traffic control signal cabinets includes EVP phase selectors, APS central control units, and Video image processors. Equipment shall be integrated into the ~~City~~ CONTRACTOR provided traffic control signal cabinets by the Contractor.

Cable for GPS EVP shall be 11 conductor cable supplied by the manufacturer or manufacturer recommended alternative.

SS-3.3 CONSTRUCTION REQUIREMENTS

A EVP Equipment

Install EVP equipment in accordance with MnDOT 2565 "Traffic Control Signals" and as shown on the Plans. Integrate cabinet equipment into new traffic control signal cabinets. Use internal cable routing (through the base of the units) for radio/GPS EVP units.

SS-3.4 MEASUREMENT AND PAYMENT

Providing and installing materials and electrical equipment to provide for two (2) complete operating Emergency Vehicle Preemption (EVP) system at the following locations:

- System "A" – Railroad Street and Canal Park Drive/North Lake Avenue in Duluth, St. Louis County, and
- System "B" – Railroad Street and South Lake Avenue/Lake Place Drive in Duluth, St. Louis County,

as contained in these Special Provisions and as shown in the Plans will be paid for under Item No. 2565.501 (EMERGENCY VEHICLE PREEMPTION SYSTEM A) and Item No. 2565.501 (EMERGENCY VEHICLE PREEMPTION SYSTEM B) at the Contract price per LUMP SUM.

SS-4 (2565) TRAFFIC CONTROL INTERCONNECT

SS-4.1 DESCRIPTION

This work consists of providing and installing fiber-optic vaults, conduit, fiber-optic interconnect cable, fiber optic testing, etc.; all for traffic signal interconnect along Railroad Street, North Lake Avenue, and South Lake Avenue where shown in the Plans, in accordance with the applicable provisions of MnDOT 2565; with the current edition of the National Electrical Code; with the Plans, and as follows.

SS-4.2 MATERIALS AND CONSTRUCTION

(1) Terminate the new interconnect cable in each intersection traffic signal cabinet in a City approved and Contractor provided and installed splice enclosure and termination panel which includes singlemode pigtails (with cap plates for singlemode sleeves) and all other required materials and electrical equipment. Complete all splicing and connections at each signal system controller cabinet.

(2) Materials and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products. All materials and equipment provided must be new, of first quality, of the latest design, and be completely free from defects in material and poor workmanship. All like pieces of equipment must be of the same type and manufacturer to assure uniformity, interchangeability of components, single responsibility, and most satisfactory service.

(3) Ensure that all materials, work methods, and equipment comply with the standards of the National Electrical Manufacturers Association, Electronic Industries Association, Underwriters Laboratory Inc., National Electrical Code, Telecommunications Industries Association, local codes and ordinances, the requirements of the Contract, these Special Provisions, and the Plans.

(4) Warranty all F & I materials and workmanship for a minimum of one year after completion and acceptance of the work. Specific items within these Special Provisions may require longer warranty periods. Completion of all construction obligations, documented as the Final Completion Date on the Change in Construction Status report, is the beginning of the warranty period.

(5) Have all fiber-optic cable installation work be supervised by trained and experienced personnel. Complete all cable terminations using qualified technicians.

(6) Quantities shown in the Plans are estimates only. Increases or decreases in final quantities shall not be grounds for unit price adjustment requests. Quantities requested for work not covered by unit bid prices will be paid for as Extra Work in accordance with MnDOT 1904.

(7) Use stainless steel hardware (e.g. mounting bolts, nuts, washers, and external hinges, etc.) on all fiber optic vaults. Round and smooth sharp corners and edges on all fiber optic vaults.

(8) Provide and install necessary miscellaneous equipment to make a complete and operating installation in accordance with the Plans and Special Provisions and include the following items **in each new ~~City~~ CONTRACTOR provided controller cabinet:**

- Fiber optic splice enclosures
- Fiber optic termination panels
- Pigtails (singlemode) and patch cords (6 foot patch cables)

- Caps for singlemode (LC connectors)

(9) Non-Metallic Conduit

Provide and install UL listed Non-Metallic Conduit, in accordance with the MnDOT Standard Specifications, MnDOT 3803, MnDOT Standard Plans/Plates, the Plans, and the following:

- Do not apply the requirement for Red-colored conduit contained in MnDOT 3803.
- Use industry standard couplings.
- If adhesives and solvents are used, use ones that are compatible with the materials to be adhered.
- Construct all NMC proposed to contain FO cable to be continuous. Do not use stick conduit.
- Construct all NMC proposed to contain FO cable a minimum of 0.9 meters (36 inches) below the finished grade.
- Construct all NMC under roads a minimum of 60 inches below finished grade and construct it continuous without joints.
- Construct NMC with PVC or HDPE, Schedule 40, with the exception of conduit above ground or under roadway surfaces. Construct heavy-wall rigid PVC or HDPE, Schedule 80 for conduit above ground or under roadway surfaces.
- Construct 3.15 inches wide, stretchable, orange warning tape between 18 inches and 12 inches below the surface over all NMC bearing communication cable (including FO cable). Provide the following permanent legend: CAUTION: FIBER OPTIC CABLE BELOW.

NMC FOR BLOWN FO CABLE

Apply the following provisions to Non-Metallic conduit:

- Construct NMC complying to the following material characteristics:

  1.5 inches in diameter as called out in Plans.

  Construct couplings with a minimum pressure rating of 130-psi for the 1.5 inch diameter NMC.

- Construct flexible and direct buried conduit which is continuous. Plowed duct is preferred over trenched duct.
- Backfill open trench installations of NMC for Blown FO Cable with granular material to six inches over the top of conduit elevation.

(10) Directional Bored Conduit

Provide and install bored conduit in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, the Plans, and the following:

Conform but do not be limited to the following MnDOT Specifications except as modified by these provisions:

- Installation: MnDOT 2565.3.
- NMC: MnDOT 3803. Do not apply the requirement for Red-colored conduit contained in MnDOT 3803.
- RSC: MnDOT 3801.
- Expansion Fittings: MnDOT 3839.

Use Schedule 80 Heavy-wall rigid PVC or HDPE for installation under an existing roadway or paved surface.

Place all conduit under roadways continuous without joints.

Place Bored Conduit under slope paving without damaging the slope paving.

Place Bored Conduit 1.5 meters (60 inches) below the bottom of the finished driving surface. Extend Bored Conduit under roadway surfaces 10 feet beyond the pavement edge or curb line. Do not exceed one foot vertical per five feet horizontal transition slope from the routine 0.9 meters (36 inches) depth of direct-buried cable to the 1.5 meters (60 inches) depth under a roadway or paved shoulder.

Place Bored Conduit at depths according to the Plans if the Plans calls out for deviations from these specifications.

Use standard bell ends on all conduit ends to prevent damage to cables during installation.

(11) Fiber Optic Cable

Provide and install **armored** fiber optic cable in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, the Plans, and the following:

MnDOT approved armored Fiber Optic Cable is listed on the following website:
http://www.dot.state.mn.us/products/trafficmgtsystems/index.html

(12) Fiber Splice Enclosure

Provide and install outdoor fiber splice enclosures in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, the Plans, and the following:

MnDOT approved Outdoor Fiber Splice Enclosures are listed on the following website:
http://www.dot.state.mn.us/products/trafficmgtsystems/index.html

(13) Fiber Optic Termination Panel

Provide and install fiber optic termination panels in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, the Plans, and the following:

MnDOT approved Fiber Optic Termination Panels are listed on the following website:
http://www.dot.state.mn.us/products/trafficmgtsystems/index.html

Terminate all fibers in each traffic signal controller cabinet as shown in the Plans.

(14) Project Testing and Documentation Submittals

Provide Project Documentation Submittals for Components, FO Cable Testing, and As-builts in accordance with MnDOT Standard Specifications, MnDOT Standard Plans/Plates, the Plans, and the following.

Present Project Testing and Documentation Submittals directly to the Engineer. Present Project Testing and Documentation Submittals as three complete packages unless prior authorization is made with the Engineer. Complete packages will be defined as one submittal for Components, one submittal for Testing, and one submittal for As-builts. Include all required documentation in each submittal. Payment will not be made until a submittal package is received and approved by the Engineer.

Provide Project Testing and Documentation Submittals for the following items:

(A) Components

(B) FO Cable Testing.

(C) As-builts

Apply the following provisions to project component testing and documentation submittals for Components:

- Submit Component Documentation Submittals to the Engineer within two weeks subsequent to contract approval. The Contractor will be subject to a daily charge assessed at a rate of $200.00 per day for each day or portion thereof with which the Engineer determines that the Contractor has not complied. The Engineer will reserve the right to allow the Contractor greater than two weeks after contract approval to make submittals.

- Submit two sets of component specifications and/or shop drawings for each project component, assembled or whole, to the Engineer. Forward any recommended revisions to the Manufacturer.

- Two separate copies of project Component documentation shall be submitted as a complete and organized package unless otherwise directed by the Engineer.

- The Engineer will approve or reject submittals within two weeks of receipt. The Component Documentation Submittal package will be approved by the Engineer prior to installation or payment for the component.

- Include the Manufacturer's name, specifications, and detailed drawings as part of the Project Component Documentation submittals for all items.

- Do not submit manufacturer's information for components already listed on the Traffic Management System/ITS APL. This includes components listed on the TMS/ITS APL when the Contract is advertised and at the time the Testing and Documentation Submittal is submitted.

Apply the following provisions to FO Cable Testing Submittals:

- Submit Fiber Optic Testing Documentation Submittals to the Engineer within 30 Working days subsequent to the last test. **The Contractor will be subject to a daily charge assessed at a rate of $200.00 per day for each day or portion thereof with which the Engineer determines that the Contractor has not complied**. The Engineer will reserve the right to allow the Contractor greater than 30 Working days after contract approval to provide submittals.

- Submit Documentation of test equipment calibration and certification (See FIBER OPTIC CABLE TESTING elsewhere in these Special Provisions) as part of the Project Documentation Submittal for FO Cable Testing along with the test results. Provide a calibration certificate dated no more than two years prior to the last date of FO Cable Testing. FO cable testing will be rejected if calibration certificates are out of date.

- FO Cable test parameters are identified in a later section of this document. See FIBER OPTIC CABLE TESTING elsewhere in these Special Provisions.

- Utilize a Manufacturer-recommended "OTDR Trace Analysis" software program. Conform the software as noted elsewhere in these Special Provisions. Provide Engineer with an "OTDR Trace Analysis" Viewer application.

- Notify the Engineer prior to beginning the FO system testing. Provide all test documentation electronically on a CD or USB flash drive. The Engineer may observe each test.

- Store OTDR electronic files under a directory folder named by the Launch Point cable identification (ID) description found on the test schematics. Include the following items in the files:

  a. Date of each test completed.
  b. The "Index of refraction" for the FO cable as recorded on the cable spool by the manufacturer or for existing FO cable, the Index of Refraction that was utilized.
  c. File names and notes as described by the County file naming convention. See FO CABLE TESTING DOCUMENTATION elsewhere in these Special Provisions for file naming convention example.

- Provide a test summary describing the following items:

  a. Final measurements that are out of range.
  b. Engineer approved changes in specified methods.
  c. OTDR manufacturer, equipment model number, and last date calibrated.
  d. Dates of tests performed by both Power Meter & OTDR.
  e. The method used to set a launch power reference regarding the additional launching cables used for Power Meter testing.

f. Special circumstances.

- Provide the Engineer with the Manufacturer's reel (spool) test documentation. This is required for all Contractor furnished FO cable.

Submit As-built drawings with deviations from the Plan shown in red on the Plan. These sheets do not satisfy the Contractor's responsibilities with regard to Gopher State One Call.

Submit As-Built Documentation Submittals to the Engineer subsequent to construction completion. Provide As-Built Documentation Submittals reflecting the final location of all items constructed for the project, not just the Components and FO Cable. Additionally, include any roadway or other construction included in the project.

(15) Fiber Optic Cable Testing

Perform fiber optic cable testing in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, with the Plans, and as follows:

A FO Link will be defined as "any fiber with a connector at one end originating in a cabinet; and the other end with a connector in another location within a cabinet.

Notify the Engineer prior to FO system splicing and testing. The Engineer, or a representative, may observe splicing or testing. Provide test documentation electronically.

Use an OTDR and Power Meter with current calibration certificates to perform the FO Cable testing required. Submit test equipment calibration information and certification documentation as part of the Project Documentation Package (with test results).

Provide a calibration certificate dated no more than two years prior to the last dates of FO cable testing.

Notify the Engineer of problems encountered with existing cable plant or hardware before testing is completed. Notify the Engineer by email within two Working days of noticing the problem.

FO Cable Testing will be rejected if calibration certificates are out of date.

OPTICAL TIME DOMAIN REFLECTOMETER "OTDR" TESTING

Apply the following provisions to OTDR Testing:

- Comply with the latest issue of Telcordia Document GR-196. In addition, comply the OTDR performance with the following minimum requirements:

  a. Event dead zone shall be less than or equal to three meters.
  b. Attenuation of the dead zone is less than or equal to 5 meters.
  c. Provide a dynamic range of 25 dB or greater.
  d. Set the test pulse width to the shortest value allowed by the OTDR.

- **OTDR Test files**

  a. Use MnDOT's typical file naming convention for test files. See **FO CABLE TEST DOCUMENTATION** elsewhere in these Special Provisions for file naming convention and example.

  b. Include the date of testing and the "Index of refraction" for the FO cable as recorded on the cable spool by the manufacturer or for existing FO cable, the Index of Refraction that was utilized, as part of the test files.

  c. Test FO Links bi-directionally per EIA/TIA 455-59, FOTP-59, except as otherwise noted. Use a 500 m (1650 foot) patch cord as a launch cable when testing.

  d. Measure and record each FO Signature for the completed SM FO Link at 1550 nm or 1300 nm for MM.

  e. Test each FO Link. Test each fusion splice in the forward and backward direction, record, and denote by FO Vault location. Record all events which indicate a loss greater than or equal to 0.01 dB, within the FO Signature as "Event Notes" describing the corresponding vault location. Event Notes will not be required for splices indicating loss less than 0.01 dB. Provide an explanation for all events that do not align with a vault.

  f. The OTDR measured insertion loss of the launch connector shall be less than 0.8 dB and the OTDR measured back reflection loss shall be less than -40dB. Typical back reflection loss is between -40dB and -60dB. Acquire approval from the TMS Integrator for any exceptions and document them at the time of testing.

  g. The acceptable average loss through a fusion splice, when measured at wavelengths of 1550 nm for SM and 1300 nm for MM, will be no more than 0.15 dB. Calculate the average by adding the bi-directional testing values and dividing by 2.

  h. Test each FO Link after splices are sealed within their enclosure or panel. If a FO Link fails, re-splice that FO Link and retest all FO Links within the enclosure or panel. A maximum of three splice attempts to achieve passing results will be allowed.

POWER METER TESTING

Apply the following provisions to Power Meter Testing of FO Links:

- Use a light source and power meter conforming to EIA/TIA 455-171, FOTP-171, and OFSTP-14, except as otherwise noted, to bi-directionally test the cable plant.

- Measure and record each directional value for the completed SM optical link at 1550 nm or 1300 nm for MM. (See FO Schematics Plan Sheets).

- Provide power meter measurements in dB.

a. Do not exceed the result of the following formula for SM link measurements:

0.4*[Link length of FO Cable in kilometers]+1

b. Do not exceed the result of the following formula for MM links:

[Link length of FO Cable in kilometers]+1

- Correct out of range measurements on the constructed FO Links. If after performing corrective action an acceptable measurement has not been achieved, notify the Engineer.

FO CABLE TEST DOCUMENTATION

Document OTDR and Power Meter test results to verify specifications are met, document the FO Link loss, FO cable distance between splices and terminations, and the fusion splice losses. The Engineer will review this documentation for approval and apply the following provisions to FO Cable Test Documentation:

- Provide post installation documentation on a CD or USB flash drive.

  a. Store measurements recorded on copies of FO schematics as PDF formatted files. Type the text font legibly as determined by the representative reviewing the measurements. Repeat and record again any measurements the County determines are illegible.

  b. Store OTDR files in a separate folder on the CD or USB flash drive if re-splicing is required to achieve passing results.

     - Measure and record the following values for all FO cables:

  c. FO cable length markings at all splice and termination locations on the FO schematics.

  d. Show on the FIBER OPTIC SCHEMATICS fiber distances derived from OTDR testing and the FO Index of Refraction (usually included on FO cable spool documentation). Provide the Index of Refraction utilized for existing FO cable,

  e. Attenuation of each FO Link measured in each direction.

  f. Event notes for each splice indicating loss greater than or equal to 0.01dB. Identify each splice location and be consistent with each FO schematic vault location. Provide an explanation for all events that do not align with a vault.

  g. Signatures of the FO cable span and events using typical MnDOT file naming convention. See below in this section for file naming convention example.

  h. Attenuation of each FO link, in both directions, as measured with a light source and power meter at 1550 nm wavelength for SM and 1300 nm wavelength for MM.

  i. Provide Fiber Optic Schematics indicating power meter and splice loss results, power meter test reports as pdf files, and OTDR trace files on the FO Schematics on the Contractor provided CD or USB flash drive.

- Name OTDR files as follows:

  a. Develop the OTDR file name from left to right in the following order:

     i. FO cable launch point (trunk or pigtail FO cables).

ii. Add the designation North, South, East, or West (N, S, E, or W) after the FO Trunk ID or FO Pigtail ID; this is the direction of the optical test pulse traveling from the OTDR launch point along the majority of cable under test. This will not always be the direction the cable leaves the OTDR launch point.

iii. FO cable type (S=Single Mode, M=Multimode) and strand count.

iv. Filename extension (data format) proceeded by a period.

Fiber Optic OTDR File Naming Convention

LAUNCH DIRECTION
┌ ------ **CABLE I.D** -------- ┐ | ┌ **FIBER** ┐ ┌ **EXT** ┐
C A B 6 9 4 – 50 . 47 W S 0 4 . ***XXX***

CABLE I.D. = Trunk or pigtail FO cable I.D. number. Number of characters may vary.

LAUNCH DIRECTION = Direction in which the OTDR is launching (N, S, E or W). This is the direction of the optical test pulse traveling from the OTDR launch point along the majority of cable under test. This will not always be the direction the cable leaves the OTDR launch point.

FIBER = Fiber Type, (S= Single mode), (M= Multimode) and Fiber Number (example: 01...04...08...48...76...100...144). Number of characters may vary.

EXT = Data file format

The OTDR file **"Fiber Notes"** field includes the Project Number and the origin of the test launch (i.e. the complete name of the cabinet, or temporary termination point).

No measurement will be made of the various Items that constitute Fiber Optic Cable Testing, but all such work will be included in the Traffic Control Interconnect bid item.

(16) Fiber Optic Cable Splicing

This work consists of fiber optic cable splicing, in accordance with the MnDOT Standard Specifications, MnDOT Standard Plans/Plates, with the Plans, and as follows:

Indoor Pigtails:

Apply the following provisions to the Indoor Pigtails for FO Pigtail Termination:

- Do not reuse existing Indoor pigtails.
- Secure boots to the jacket with a pliable adhesive.
- Land connectors on patch panel Bulkhead Adaptors.

Fiber Bulkhead Adaptors:

Apply the following provisions to the SM FC-PC and MM ST Fiber Bulkhead Adaptors for fiber

cable splicing within cabinets:

- Use Fiber Bulkhead Adaptors with the following features:
  a. One-piece construction.
  b. Metallic bodies.
  c. Zirconia ceramic sleeves.

- Use fusion type splices. Mechanical splices are prohibited.

- FO Cable Splicing locations are within cabinets and vaults.

Adhere to the FO cable manufacturer's methods, recommendations, materials, and techniques for splicing. Use splicing equipment in good working order, properly calibrated, and meeting all industry standards and safety regulations.

Construct the FO cable preparation, splice enclosure installation, and splicing in accordance with industry standards. Minimize mechanical stress and splicing locations by training the FO cable into final position, concurrently observing the minimum bending radii of the FO cable. The minimum bending radii of the FO cable is 20 times the diameter of the cable or as per the manufacturer's requirements, whichever is greater.

The City will direct the Contractor as to which individual fiber are to be spliced at each location.

Strictly observe cleanliness and freedom from contamination with respect to splicing materials and joint construction. Upon completion of the splicing operation, deposit all waste material in suitable containers, remove from the job site, and dispose in an environmentally acceptable manner.

PRESSURE TEST

Use the following test procedure to ensure that the outdoor fiber splice enclosure is properly sealed:

(A) Perform testing in the presence of the Engineer when the Outdoor Fiber Splice Enclosure is in its final hanging position.

(B) Pressurize the enclosure to between 8 to 10 psi and wait 45 seconds. During the 45 second wait, spray soapy water around the seal to check for leaks.

(C) Recheck the pressure. The enclosure should not have lost more than 2.5 psi.

(D) If the pressure loss is not greater than 2.5 psi and no leaks were detected when soapy water was sprayed around the seal, the enclosure requires no further testing.

(E) If the pressure loss is greater than 2.5 psi or leaks were detected when soapy water was sprayed around the seal, repair any leaks, and retest the enclosure.

MnDOT approved products for Indoor Pigtails are listed on the following website:
http://www.dot.state.mn.us/products/index.html

(17) Fiber Optic Cable Installation Requirements

Comply with MnDOT 2550.3 and the following provisions for FO Cable Installation Requirements:

(A) Store additional lengths FO Cable in end-equipment Control cabinets, and in vaults.

(B) Remove the following lengths of outer jacket and armor from field terminated FO Cable for fiber management:

a. Remove eight to 15 feet of the outer jacket of cable terminating an Outdoor FO Splice Enclosure.
b. Remove 33 feet of the outer jacket of cable terminating in a ground mounted control Cabinet or Signal Cabinet.

(C) Place FO Cable a minimum of 36 inches below finished grade.

(D) Place FO cable a minimum of 60 inches below finished grade when it is placed under a road.

(E) Employ the Air Assisted installation method for lengths of FO Cable over 600 feet.

(F) See elsewhere in these Special Provisions for grounding requirements.

(G) Calculate expected tension on the FO Cable and pulling tape prior to installing the FO Cable in conduit runs. Distribute the pulling force between the inner strength member and the aramid fibers by securing both to the main pulling device.

(H) Utilize a “break-away” type pulling attachment to protect against over stressing the FO Cable. Do not use a cable grip that pulls only on the outer jacket to pull FO Cable.

(I) Damage to the FO Cable from any source or exceeding the manufacturer’s recommended tensile strength limits or cable-bending radius is cause for the cables to be rejected. Ensure a minimum bend radius of ten inches during installation (loaded cable) and minimum bend radius of eight inches after installation (static cable).

(J) Often, FO Cable is pulled through conduit/handhole networks. Using the 24 inches diameter handholes as a fiber pull box, is likely to exceed the minimum loaded bend radius and cause damage to the cable fibers. Do not use the handhole as a fiber pull box.

(K) Provide slack FO cable for FO cables spliced within vaults. Provide 70 feet of slack FO Cable coiled in these vaults per each vault entrance/exit.

(L) Backfill open trench installations with granular material six inches over the FO Cable conduit elevation.

(M) **Air Assisted FO Cable**

a. Long radius bends shall be utilized in equipment foundations and other situations requiring the negotiation of sharp angles.

b. Place the conduit utilizing pressure tight splices.

i. Seal one end of the conduit and pressurize the conduit utilizing a sealed blowing machine.

ii. Maintain 130 psi in the conduit without realizing significant pressure loss
iii. Use care near pressurized ducts.

c. High air speed blowing shall require the front end of the FO Cable to be endcapped to prevent the cable from getting hung up in the duct.

d. Utilize proper air seals to fit the OD of the FO Cable.

e. Provide proof that the duct is properly spliced and not crushed by blowing a hard mandrel through the duct

f. Clean and dry the duct utilizing the following procedures

i. Blow a tight fitting foam carrier through the duct at high pressure. Blow the foam carrier at an approximate velocity of 100 fps.
ii. If excess water and/or dirt is expelled from the duct, repeat the process until minimal water and/or dirt is observed.
iii. Dry the duct with airflow.

g. For high speed air machines (no missile), inject the recommended amount of approved lubricant and spread it with a foam carrier. For piston type machines, inject the majority of the lubricant in front of the missile with some placed behind the missile.

h. For push/pull machines, attach the piston to the FO Cable and insert the piston into the duct.

i. For high air speed machines, hand push approximately 100 feet of FO Cable into the duct prior to activating the machine.

j. Use caution in bringing up the air and hydraulic pressure.

MnDOT approved Pre-terminated Armored FO Pigtail Cable, FO Trunk, and Armored FO Pigtail Cable is listed on the following website:
http://www.dot.state.mn.us/products/trafficmgtsystems/index.html

(18) Fiber Optic Connectors

Provide and install City approved fiber optic cable connectors on the ends of all fibers terminating in a traffic signal controller cabinet or fiber optic splice vault. Fiber optic connectors shall be approved by the Engineer prior to procurement and use on the project.

SS-4.3 MEASUREMENT AND PAYMENT

Providing and installing all labor, materials and electrical equipment as noted in the Plans and in these Special Provisions, all to provide for a complete operating fiber-optic interconnect system Railroad Street, North Lake Avenue, and South Lake Avenue shall be measured and paid for under Item No. 2565.501 (TRAFFIC CONTROL INTERCONNECT) at the Contract price LUMP SUM, which price shall be compensation in full for all costs incidental thereto.