DESIGNERS, use these specifications together with Lighting Special Provisions to complete High Mast Lighting Special Provisions for the project.

All RED text must be removed from the special provisions prior to the Special Provisions being submitted for project letting

DIVISION SL
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The following paragraph is required for all MnDOT or State Aid project contracts.

All RED text must be removed from the special provisions prior to the Special Provisions being submitted for project letting

SL-1 (2545) HIGH MAST LIGHTING SYSTEMS

This Work consists of providing labor, equipment, and materials for construction of a high mast lighting system in accordance with the Contract Documents and the following:

SL-1.1 MATERIALS

A High Mast Light Towers (HMLTs)

Design high mast light towers (HMLTs) in accordance with the AASHTO First Edition 2015 LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals including Interim Revisions and the following:

Design wind load based on Extreme 1 Load Combination using a high risk 1700 - year mean recurrence interval (MRI) wind speed

Fatigue Design Case using Importance Category I

Design to withstand static and dynamic loads the complete high mast lighting units will be subjected to while in service. Use design loading that accommodates for installation of full complement luminaire ring assembly of 6 luminaires with a total effective projected area (EPA) of 60 square feet

Design HMLTs to the MnDOT standard tower heights of 100 feet, 120 feet, and 140 feet unless otherwise specified on the Plan

Fabricate HMLT heights designated with the high mast lighting unit types shown on the Plan and in Table High Mast Lighting SL-1:

Table High Mast Lighting SL-1
High Mast Lighting Unit Types / HMLT Heights

Type	Height in Feet
X - 100	100
X - 120	120
X - 140	140

*X = Variable number of luminaires for each high mast lighting unit. Actual number of luminaires for each lighting unit type are shown on the Plan

Provide submittals of HLMTs for Engineer's review and acceptance in accordance with 2471.3 within 38 calendar days after approval date of the Contract. Provide with the submittals, a list of suppliers of lowering system components and parts, and computations of the HMLT design and stress analysis.

Each fully assembled HMLT includes shaft and base, lowering system, circuit breaker enclosure, and the high mast light tower manufacturer's installation, operation, and maintenance manuals.

B Shafts and Bases

Provide the material, manufacturing, and fabricating for shafts and bases in accordance with 2471 "Structural Metals" and the following:

(1) Galvanized steel

- (a) Grade 50
- (b) In accordance with 3306
- (c) Galvanized in accordance with 3394

(2) Weathering steel

- (a) Grade 50
- (b) In accordance with 3309
- (c) ASTM A588, Grade 50

Only shop welds are allowed on shafts and bases meeting the following;

(3) Weld longitudinal seams at a uniform rate of travel using

- (a) Partial joint penetration (PJP) with at least 60 percent penetration
- (b) Complete joint penetration (CJP) in slip joint areas

(4) Fabricate bases using

- (a) 100 percent penetration circumferential welds to attach to shafts, and
- (b) Two circumferential fillet welds to attach the base plate to the high base skirt

(5) The use of back up bars are allowed that are

- (a) In accordance with the same material specification as the shaft,
- (b) Continuous, and
- (c) Contoured for full contact,

(6) Inspect 100 percent of the longitudinal seam welds around the slip joint areas using

- (a) The Ultrasonic Test Method (tension criteria) for material thicknesses 5/16 inch and greater
- (b) The Magnetic Particle Test for material thicknesses less than 5/16 inch

(7) Inspect 25 percent of the remaining longitudinal seam welds using the Magnetic Particle Test

(8) Inspect 30 percent of the fillet welds using the Magnetic Particle Test

(9) Inspect 100 percent of circumferential welds using the Ultrasonic Test Method (tension criteria)

B.1 Shafts

Fabricate shop welded one-piece length shafts, or cold formed telescoping shaft sections meeting the following:

(1) No more than 4 sections per shaft
(2) Joined by telescoping the bottom of the upper section over the top of the lower section
(3) Factory pre-fitted to assure proper fit
(4) Match marked in accordance with 2471.3J.3 “Match Marking” to aid in field assembly,
(5) Press fit field assembled without field welding
(6) Mating section joints overlap at least 1 ½ times the outside diameter of the bottom of the upper section
(7) Sections wrapped with a covering at the factory to protect against scratches and mars during delivery and staging on the project site

B.2 Bases

Fabricate tapered high bases integral to the shafts and meeting the following:

(1) Adequate room to house

(a) Winch with integral power units or winch with portable power units
(b) Circuit breaker enclosures
(c) Lowering system cables and components
(d) Electrical wiring, cables, splices, connectors, and components

(2) Circuit breaker enclosure support mount

(a) Located inside the base
(b) Designed to support the enclosure
(c) Placed to provide easy access to the enclosure
(d) Positioned in the base so the enclosure does not interfere with lowering system operations, anchor rod tightening, and the opening and closing of the base access doors and panels

(3) Two bonding studs

(a) Mounted inside the base in plain view when the front door and rear access opening is open for visual inspection of the ground lug terminations
(b) One ground lug located near the front door and the other near the rear access opening
(c) Positioned to avoid interfering with normal operation of the HMLTs, anchor rod tightening, and the opening and closing of the base front door and rear access opening
(d) Each sized properly in length and diameter to accommodate a bronze bonding lug for the lightning protection conductor, the cable copper shield of the direct buried lighting cable, and a bronze bonding lug for the green insulated stranded 6 AWG conductor from the circuit breaker enclosure

(4) Base plates with anchor rod holes to accommodate 2 inch diameter anchor rods, and bolt patterns and bolt circles that correlates with Standard Plate No. 8135 “Anchor Rod Assembly For Light Tower Foundation”.
Verify base plate holes, bolt patterns, and bolt circles match the designated HMLTs foundation anchor rod assemblies specified on the Plan

(5) Allow access inside the base for tightening anchor rods, making electrical connections, operating the lowering system, and maintaining components by providing reinforced access openings meeting the following

(a) Front openings sized at least 16 inches x 21 inches x 35 inches located at 0 degrees (base front) with hinged front doors and tamper proof fasteners to secure the opening
(b) Rear access openings sized at least 10 inches x 15 inches located at 180 degrees from the front door with bolt on access covers
(c) Front doors and access covers made from the same material specification as the base

(6) Accessible compartments located inside the bases for the manufacturer’s HMLT operation and maintenance manuals. Ensure the compartments are weather resistant and rodent proof. Manufacturer’s HMLT operation and maintenance manuals placed inside the compartment of each base

(7) Bases wrapped with a covering at the factory to protect against scratches and mars during delivery and staging on the project site

B.3 Lowering Systems

Provide HMLTs with mechanical lowering systems for raising and lowering luminaire rings to service luminaires from the ground that include the following:

(1) Stainless steel masthead and luminaire ring assembly,
(2) Winch unit with integral power unit or winch unit with portable power unit,
(3) Hoisting cables,
(4) Power cords, plugs, connectors, junction boxes, and controls, and

Manufacturer’s 2-year warranty against failure of the lowering system. The warranty does not cover defects or malfunction caused by

(1) Misuse
(2) Abuse
(3) Improper maintenance
(4) Failure to follow operation instructions
(5) Use with equipment with which it is not intended to be used
(6) Unauthorized alterations, modifications, or repair to the lowering system

B.4 Mast Head and Luminaire Ring Assemblies

Provide mast heads and the specified luminaire rings (number of luminaire tenons per ring) assigned to each high mast lighting unit shown on the Plan meeting the following:

(1) A method of securing the luminaire ring in a horizontal position when fully raised with a ring support latch system located in the base, readily accessible and easily viewed from ground level

(2) A means to notify the operator when the raising operation is complete and the luminaire ring is secure. Ensure the luminaire ring support is not dependent on the winch assembly

(3) Luminaire ring guide systems to center the luminaire ring when fully raised and keep it in position under windy conditions

(4) A system for relieving tension on the lower cables and winch unit when the luminaire ring is fully raised and held firm to the masthead. The system is designed to hold the weight of the luminaire ring assembly including the luminaires and an additional 300 pounds

(5) Stainless steel mast head assemblies with

(a) Hinged covers with a closed position locking mechanism
(b) Cable centering guide system
(c) Stainless steel sheaves for the mast head assembly with permanently lubricated bronze bearings and stainless-steel axle pins
(d) Lightning rods that provide a 45-degree cone of protection and are mechanically attached to the HMLT to form an electrically conductive path

(6) Cast aluminum power cord sheaves with

(a) Smooth rounded V grooved walls and bottoms designed to accommodate the diameter size of the power cord
(b) Guards to prevent the power cord from lifting off
(c) Covers to protect against ice accumulation, nesting insects, birds, and other contaminants that may interfere with the operation of the lowering system

(7) Stainless steel luminaire rings that include

(a) Inner rings lined with a weather resistant shock absorbing material for protecting the pole and luminaires during the raising and lowering of the ring
(b) Enclosed wire raceways accommodating the wiring for the specified number of luminaires on each HMLT lighting unit shown on the Plan
(c) Junctions boxes, weathertight connectors and luminaire test cord inlets
(d) 2 3/8 inches outside diameter luminaire tenons of the proper length to accommodate MnDOT approved high mast luminaires
(e) Tenons symmetrically placed on typical luminaire rings for three, four, or six luminaires as specified for each lighting tower unit shown on the Plan
(f) Unused tenons place a counterweight equal in weight of a luminaire and a weather resistant cap over the open end
(g) Factory welded ¾ inch NPT internally threaded hubs on a tenon to accommodate a MnDOT approved air obstruction light. One hub per high mast lighting unit. Cover the open hubs with manufacturer installed threaded hub caps of the same material specification as the hub. Apply anti-seize lubricant to the threads before inserting the hub cap, and
(h) Stainless steel fittings, fasteners, and miscellaneous hardware

The DESIGNER MUST DETERMINE if the lighting system will use integral or portable power units. Include the following Paragraph if the system will use integral power units.

All Red text must be removed from the special provisions prior to the special provisions being submitted for project letting.

B.5 Winch Units with Integral Power Units

Provide winch units with integral power units mounted to mounting channel plates in bases that include the following:

(1) Worm gear speed reducers with a 72:1 ratio and a housing fabricated from aluminum or corrosion resistant metals
(2) Stainless steel winch drums with calibrated adjustable clutches
(3) Input or drive pulleys equipped with brake pads to serve as a safety brake if the motor drive belt breaks
(4) Winch unit luminaire ring raising speed of at least 12 feet per minute
(5) Elastomeric bearing pads installed between the winch aluminum housing and the steel mounting channel plate for vibration isolation and to prevent electrolytic action between dissimilar metals
(6) Totally enclosed, fan cooled (TEFC) motors meeting the following

(a) At least 1.0 continuous duty horsepower (CHP)
(b) Single phase 240 VAC
(c) 60 Hertz
(d) NEMA 4 electromagnetic brakes
(e) 1725 RPM
(f) Reversible
(g) 15-amp circuit breakers
(h) Size 56C Frame

The DESIGNER MUST DETERMINE if the lighting system will use integral or portable power units. Include the following Paragraph if the system will use portable power units.
This option maintenance will have to bring a portable power unit and removable bracket to each high mast to lower the luminaire ring.

All Red text must be removed from the special provisions prior to the special provisions being submitted for project letting.

B.6 Winch Units with Portable Power Units

Provide winch units mounted inside HMLT bases to mounting channel plates designed to be used with portable motors to lower and raise the luminaire rings. Provide winch units and portable power units meeting the following:

(1) Worm gear speed reducers with a 72:1 ratio and a housing fabricated from aluminum or corrosion resistant metals
(2) Stainless steel winch drums with calibrated adjustable clutches
(3) Input or drive pulleys equipped with brake pads to serve as a safety brake if the motor drive belt breaks
(4) Winch unit luminaire ring raising speed of at least 12 feet per minute
(5) Elastomeric bearing pads installed between the winch aluminum housing and the steel mounting channel plate for vibration isolation and to prevent electrolytic action between dissimilar metals
(6) Totally enclosed, fan cooled (TEFC) motors

(a) At least 1.0 continuous duty horsepower (CHP),
(b) Single phase 240 VAC
(c) 60 Hertz

(d) NEMA 3 electromagnetic brakes
(e) 1725 RPM
(f) Reversible
(g) 15-amp circuit breakers
(h) Size 56C Frame

Portable power units become the property of the Department after completion of the Project. Deliver the units to ESS. Replace damaged units at no cost to the Department

Equip the motor with a power cord equipped with a NRTL listed, weatherproof 30-amp 480-volt pin and sleeve plug connector to mate with the power supply cord connector. Operate the motor by a spring return to neutral push button control in non-metallic enclosure on a 20-foot-long extension cord.

B.7 Hoisting Cables

Provide continuous length stainless steel winch hoisting cables from the winch drums to the mast head sheaves meeting the following;

(1) At least a 1/4 inch diameter
(2) 7 x 19 strand cable in accordance with MIL-W-5424B, Amendment 1 (USAF)
(3) Rated hoisting strength of at least 6,000 pounds
(4) Two times the length of the HMLT plus 20 feet
(5) Factory pre-wound on the winch drums

B.8 Power Cords, Plugs, Connectors, and Controls

Provide Type W flexible power cords, and NRTL listed, weatherproof 30 amp 480 VAC pin and sleeve plug power cord connectors.

Provide 4/C 8 AWG Type W cords with 30A, 480 VAC pin and sleeve female plug power cord connectors for the main power cord from the circuit breaker enclosure.

Provide spring return to neutral push button switches in weather-resistant non-metallic bodies wired to 20 foot long cords to control the winch.

Provide 4/C 8 AWG (Red, Black, White, and Green) Type W flexible cords for the luminaire power cord.

Provide to the Engineer;

(1) Specifications of the power cords the manufacturer intends to use
(2) Written statement from the manufacturer that the electrical and physical properties of the cords will serve the intended purpose, and hanging static condition in the tower will not affect performance

Provide power cords with 30 amp, 480 volt pin and sleeve weatherproof male plug power cord connectors on one end of the cord and terminate at the luminaire ring junction boxes using strain relief cord grips. Provide end fittings approved by the Engineer.

Provide 10 foot luminaire test cords and 30 amp, 480 volt pin and sleeve connectors for connecting between the circuit breaker enclosure power supply cord connector and the test cord inlet when the luminaire ring is lowered.

Provide weather tight, 4-prong grounding type pin and sleeve inlet connectors on the rings to allow the luminaires to be energized and tested while in the "lowered" position through use of the test cord.

B.9 Circuit Breaker Enclosures

Provide circuit breaker enclosures designed to be supported inside the bases meeting the following:

(1) 19 1/2 inches x 9 1/4 inches x 5 1/8 inches (H x W x D)
(2) NEMA 3R
(3) One 2-pole 20A circuit breaker rated for 240/480 with a minimum 22K ampere AIC

Provide 4/C 8 AWG (Red, Black, White, and Green) Type “W” flexible power cord for the enclosure to connect with the incoming power supply direct buried lighting cable. The use of SO rated cable is not acceptable as a power cord in this application. Provide enough cord length to allow removal of the enclosure from the base front door and access to the splice from the base rear access opening.

Provide long barrel compression connectors and dual wall shrink tubing for splices. For 3-way splices provide split bolts and use the approved 3-way power cable splice encapsulation kits listed on MnDOT’s APL for “lighting”.

Provide insulated stranded EGCs in accordance with 3815.2B.5 from the circuit breaker enclosures to the base bonding studs next to the front doors. Provide bronze bonding lugs sized for the conductors ends going to the base bonding studs. Ensure lug holes fit onto the bonding studs for a tight connection.

Provide strain relief rain-tight connectors for the cords entering and exiting the enclosure.

B.10 Operations and Maintenance Manuals

Provide HMLT manufacturer’s installation, operating and maintenance manuals in the required manual compartments of each HMLT base that includes the following:

(1) Spare parts lists
(2) Lubrication charts
(3) Lubricating procedures
(4) Recommended maintenance schedules
(5) Index and cross reference materials using a table of contents at the beginning of the manual

C Hydraulic Torque Wrench

Use an approved low profile hydraulic torque wrench listed on MnDOT’s APL for Lighting “Low profile hydraulic torque wrench” on the top nuts to tighten high mast light tower 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 low-profile hydraulic 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 high mast light towers. 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 done in the last 12 months from an accredited calibration service before performing the required Contractor and Manufacturer Anchor Rod Tightening Demonstration.

D Manufacturer Trained Representative and Training Certification

Provide an HMLT manufacturer trained representative on the Project site to assist in supervising the assembly and erection of high mast lighting units or certificate training by the manufacturer for at least two Contractor employees who will be on the Project site to perform or directly supervise the installation and operation of the high mast lighting units. The manufacturer training certificate certifies the individual has successfully completed in-depth training of the following;

(1) Assembly of the shaft and base sections
(2) Assembly of the lowering systems
(3) Rigging and hoisting of high mast lighting units
(4) Operation of the raising and lowering the luminaire rings
(5) Safety procedures

Submit to the Engineer training certificates showing the date when training was given and signed by an officer of the manufacturer before performing the Work.

Upon request of the Department, the manufacturer trained representative or Contractor employee will conduct training sessions of the lowering system operation on the Project site for ESS and district traffic office personnel after completion of the Work at no cost to the Department.

E High Mast Lighting Units

Provide complete high mast lighting units in accordance with the Contract Documents. A complete high mast lighting unit includes:

(1) HMLT
(2) High mast luminaires, and when required air obstruction lights
(3) Luminaire ring wiring and splices
(4) Direct buried lighting cable to circuit breaker enclosure cable splice
(5) Electrical bonding connections with the EGC, lightning conductors, copper shielding to the tower grounding lugs
(6) HMLT numbering
(7) Rodent intrusion barrier
(8) Miscellaneous electrical connectors and hardware

F High Mast Luminaires

Provide MnDOT approved symmetrical and asymmetrical type high mast luminaires found on MnDOT's APL for Lighting. Provide quantity and type specified for each high mast lighting unit type shown on the Plan.

G Luminaire Ring Wiring

Provide conductors for luminaire ring wiring in accordance with 3815, as shown on the Plan and the following;

(1) 10 AWG
(2) Stranded
(3) XHHW FR-1 rated for 90°C

H Air Obstruction Lights

If shown on the Plan, provide approved air obstruction lights listed on MnDOT's APL for lighting and the following:

(1) ¾ inches RSC nipple threaded on both ends, approximately 3 inches in length
(2) Two ¾ inch steel locknuts, one on each end
(3) Provide conductors used for luminaire ring wiring

I Light Tower Foundations

Provide T-100, T-120, or T-140, type mat or pile light tower foundations as shown on the Plans. Obtain the Foundation Analysis Design Reports (FADR) at

http://www.dot.state.mn.us/materials/borings.html

and review to determine which foundation type (mat or pile) to provide for each high mast lighting unit location.

Table High Mast Lighting SL-2 **High Mast Lighting Unit Types / Light Tower Foundation Type**	
Lighting Unit Type	**Foundation Type**
X - 100	T - 100
X - 120	T - 120
X - 140	T - 140
*X = Variable number of luminaires for each high mast lighting unit. Actual number of luminaires for each lighting unit type are shown on the Plan	

Provide two 2 inch PVC conduits. One for the lightning conductors and the other for the direct buried lighting cable, unless noted on the Plan to provide an extra 2 inch PVC conduit for an outgoing direct buried lighting cable, then provide three 2 inch PVC conduits.

I.1 Concrete Service Pads

Provide cast-in-place 6 foot x 6 foot x 4 inch thick concrete service pads in accordance with the Plan light tower foundation design sheets at each light tower foundation.

I.2 Piling

When light tower pile foundations are required, provide piling as shown on the Plan and meeting the following:

(1) Steel shells for cast-in-place (CIP) concrete piling in accordance with 3371 or Steel H-piling in accordance with 3372
(2) Weld CIP concrete piling in accordance with Bridge Detail B201. Do not use commercial drive-fit pile splices.

Drive pile to required penetration below cut-off elevation, and then continue to drive pile until nominal bearing resistance as shown in the plan has been met. If nominal bearing resistance is not achieved after piling has been driven to the estimated pile length, continue driving until bearing is achieved. If a splice is required, it will be compensated at the rate of six times the contract unit price for piling furnished and installed contract unit price. Maximum of one splice will be paid per pile. Splices made solely for the Contractor's convenience will be made at no cost to the Department.

If the actual driven piling quantity is less than the Contract estimated piling quantity, then the unused piling may be returned, and the Department will pay 50 percent of the restocking fee. Provide a paid re-stocking fee invoice for the unused piling. Ensure returned unused piling on the Project does not exceed the difference between the actual driven piling quantity and the Contract estimated piling quantity. The Department's 50 percent restocking fee

payment will be a back sheet pay item under "Piling, Restock" and supersedes claims under 1907, "Payment for Surplus Material".

The following piling costs include:

(a) Predrilling pilot holes
(b) Pile sleeves
(c) Maintaining open holes during pile driving
(d) Concrete filling or concrete encasement
(e) Re-driving pile heaved more than a ¼ inch, improperly located, and misaligned
(f) Modifying and replacing pile driving equipment
(g) Jetting piles
(h) Cutting, trimming and coating piles
(i) Providing and attaching driving shoes for CIP pipe piles
(j) Disposal of pile cut-offs
(k) Labor, equipment, and necessary required supplies
(l) Replace broken, bent, and damaged piling due to driving
(m) Replace piling damaged during hauling and handling
(n) Replace damaged piling due to the Contractor's carelessness or negligence
(o) Reinstall piling not driven in accordance with the Contract documents
(p) Replace and reinstall piling driven with the tops lower than the cut-off elevation

I.3 Grounding Systems

The grounding systems are part of the foundations. Provide grounding systems as shown on the Light Tower Foundation Standard Plan and the following.

I.3.a Grounding Systems for Mat Foundations

(1) Lightning protection conductors specified on the Plan
(2) Four 10 foot ground rod electrodes in accordance with 3818 per foundation
(3) Two bronze bonding lugs for each high mast lighting unit sized

(a) For the lightning protection conductors
(b) To fit on to the HMLT base bonding studs and under the nuts for a tight connection.

I.3.b Grounding Systems for Pile Foundations

(1) Lightning protection conductors specified on the Plan
(2) Two exothermic grounding connectors for each pile foundation as shown on the Plan sized for the lightning conductors and designed for welding to the pile used on the Project
(3) Two bronze bonding lugs for each high mast lighting unit sized

(a) For the lightning protection conductors
(b) To fit on to the HMLT base bonding studs and under the nuts for a tight connection

The DESIGNER MUST DETERMINE if the lengths of lighting cable runs require line loss calculations. In some cases, the line loss may require the use of Direct Buried Lighting Cable, 4 Conductor 2 AWG (4/C 2AWG)–for longer runs instead of Direct Buried Lighting Cable 4/C4 AWG. Line loss calculations should be conducted. The introduction of LED luminaires has basically eliminated line loss as an issue. The one exception would be the

drive motor for the lowering device. You can estimate current required for the motor at 7 amps @240 VAC. If the direct buried lighting cable 4/C 2AWG is required show on the plan and include the text below.
Allow extra time as this size cable is not inventoried by any distributors.
With the introduction of LED luminaires its very unlikely 4/C 2AWG conductors will be required.

All Red text must be removed from the special provisions prior to the special provisions being submitted for project letting.

J Direct Buried Lighting Cable 4 Conductor 2 AWG (4/C 2 AWG)

Provide direct buried lighting cable as specified in 3815.2 with 2 AWG conductors instead of 4 AWG.

Install the direct buried lighting cable 4/C 2 AWG at the locations shown on the Plan.

SL-1.2 **CONSTRUCTION REQUIREMENTS**

A Light Tower Foundations

Construct light tower foundations as follows:

(1) Foundation type (mat or pile) as specified in the Contract Documents
(2) In accordance with the Light Tower Foundation Standard Plan
(3) At each high mast lighting unit location shown on the Plan install grounding systems as shown on the Plan and as follows:

(a) Install an extra 2 inch PVC conduit in the foundation when noted next to the high mast lighting unit shown on the Plan for an outgoing direct buried lighting cable.
(b) Ensure the conduits are positioned inside the smaller opening of the upper anchor rod base plate assembly on the HMLT base rear access opening side as shown on the Plan.
(c) Place Department provided ball locating markers at the direct buried lighting cable conduit stub-out ends before backfilling around the foundations.

A.1 Concrete Service Pads

Install cast-in-place concrete service pads in front of the HMLT base front doors. Stake the pad and verify the elevations with the Engineer before concrete pouring operations.

The purpose of the service pads is to provide a level working surface for the maintenance personnel while servicing the high mast lighting unit.

A.2 High Mast Lighting Unit Installation

Install complete high mast lighting units in accordance with 2545 and the following.

A.3 HMLT Installation

If HMLTs are provided in telescoping sections to the Project site, then assemble shaft sections and bases in the field and install the lowering systems in accordance with the manufacturer's assembly and installation instructions.

Install the electrical power cords, plugs, connectors, and controls for the lowering systems in accordance with the manufacturer's installation instructions. Ensure to wire the tower plugs as shown on the Plan.

Install HMLTs in accordance with 2545.3H "Pole Installation". If there are concerns with equipment downtime and completing the entire pole installation process in accordance with 2545.3H "Pole Installation", then provide one crew for installing the tower and another crew for anchor rod tightening.

B HMLT Anchor Rod Tightening

Tighten HMLT anchor rods in accordance with the MnDOT *Anchor Rod Tightening Handbook "New Installation Procedures"* and the MnDOT *Anchor Rod Tightening Form*.

Use the required low- profile hydraulic torque wrench on the top nuts to tighten anchor rods to the required torque values specified in the MnDOT *Anchor Rod Tightening Handbook.* Obtain Engineer's approval of the wrench and provide proof of calibration performed within the last 12 months form an accredited calibration service before installing HMLTs.

Complete a MnDOT *Anchor Rod Tightening Form* for each HMLT. Submit completed forms to the Engineer.

The following are hyperlinks for the MnDOT Anchor Rod Tightening Handbook and the Anchor Rod Tightening Form for Traffic Signal Mast Arm and Light Poles.

MnDOT Anchor Rod Tightening Handbook (pdf)

MnDOT Anchor Rod Tightening Form – For Traffic Signal and Light Poles (pdf)

MnDOT ANCHOR ROD TIGHTENING FORM

Date of Report:_____Project No:_____Pole Unit No:_____Pole Type_____

Torque Wrench Type:_____Model & Make:_____Serial No: _____ Wrench Calibration Cert. Date:_____

Contractor:_____ Contractor Rep. Initials_____Construction Inspector Initials: _____

Directions: Use the MnDOT Anchor Rod Tightening Handbook "New Installation Procedures" with this form when installing the pole. Complete this form in accordance with Contract Documents.

1. Verify the Installation

a) Followed Step 1 of the New Installation Procedures in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

b) Used special washers when required by the pole manufacturer or as specified in contract documents? ❑ Yes ❑ No ❑ NA

Notes: __

2. Level the Leveling Nuts and Place Pole
(DO NOT APPLY LUBRICANT UNTIL DIRECTED)

a) Followed Step 2 of the New Installation Procedures in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

b) Used pole manufacturer's standoff distance when required? ❑ Yes ❑ No ❑ NA

Notes: __

3. Lubrication

a) Followed Step 3 of the New Installation Procedure in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

Notes: _____

*Lubricant applied only to the areas shown in the "Lubrication Areas" section of the Anchor Rod Tightening Handbook.

4. Bring Top Nuts to Hand Tight and Tightening Leveling Nuts

a) Followed Step 4 of the New Installation Procedure in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

Notes: _____

*Cross tightening pattern required to tighten leveling nuts.

5. Tighten Top Nuts in 3 Torque Value Steps (20%, 60% and 100%)

a) Followed Step 5 of the New Installation Procedure in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

Notes:_____

*Cross tightening pattern required to tighten top nuts for each step.

6. Allow Rods to Relax for 10 Minutes

a) Followed Step 6 of the New Installation Procedure in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

Notes:_____

7. Re-Tighten to 100% Torque

a) Followed Step 7 of the New Installation Procedure in the Anchor Rod Tightening Handbook? ❑ Yes ❑ No

Notes:_____

DEPARTMENT OF TRANSPORTATION

C High Mast Luminaires

Install symmetrical and/or asymmetrical high mast luminaires as shown on the Plans for each high mast lighting unit and in accordance with 2545.3.

Install high mast luminaire shields on high mast lighting units when shown on the Plan or if requested by the Engineer.

Lower and raise the luminaire ring when requested by the Engineer at no additional cost to the Department.

D Air Obstruction Lights

If required, install air obstruction lights and hardware to the factory installed internally threaded hub on the tenon (slipfitter).

E Luminaire Ring Wiring

Install the wiring in the luminaire ring raceway for each luminaire as shown on the luminaire wiring details in the Plan. Install wiring for air obstruction lights when required.

Identify and label the wiring in the luminaire ring junction box for each luminaire and air obstruction lighting in accordance with the luminaire identification shown on the Plan.

F Direct Buried Lighting Cable to Circuit Breaker Enclosure Cable Splice

Install direct buried lighting cable splices in HMLT bases next to the rear access opening. Provide plenty of cable length for the splices to be accessed and removed from the base.

Connect the direct buried lighting cable supply power to 4/C 8 AWG (Red, Black, White, and Green) Type “W” cable from the circuit breaker enclosure. Install long barrel compression connectors and stagger the splices to minimize the entire transition splice size. Use dual wall heat shrink tubing on the individual splices to ensure connections are water-resistant. Use dual wall shrink tubing to cover the entire transition cable splice.

Drill a hole in the copper shielding and place under the base bonding stud next to the rear access opening. Provide plenty of copper shielding length to allow the splice to be removed through the rear access opening base.

When 3 way splices are required use split bolts connectors and install approved 3-way power cable encapsulation splices in accordance with 2545.3G. Drill holes in the copper shielding and place under the base bonding stud next to the rear access opening. Provide plenty of copper shielding length to allow the splice to be removed through the rear access opening.

G Electrical Bonding Connections

Install the insulated stranded EGCs from the circuit breaker enclosures to the base bonding studs next to the front doors. Provide plenty of conductor length to allow for the enclosures to be removed from the bases. Install bronze bonding lugs on to the ends of the EGCs going to the base bonding studs.

Install bronze bonding lugs on the ends of the lightning protection conductors and attach one of the conductors to the bonding stud next to the front door and the other conductor to the bonding stud next to the rear access opening.

Bond the direct buried lighting cable copper shielding to the base bonding studs in accordance with “Direct Buried Lighting Cable to Circuit Breaker Enclosure Cable Splice”. Place the shielding under the bronze bonding lugs of the EGC and lightning conductor and tighten the entire assembly to form an

electrically bonded and grounded connection. Apply anti-oxidant joint compound before and after assembly.

H High Mast Lighting Unit Numbering

Number the HMLT (pole) in accordance with 2545.3.

I Rodent Intrusion Barrier

Provide and install rodent intrusion barrier in accordance with 2545.3.

J Miscellaneous Electrical Connections and Hardware

Provide and install miscellaneous electrical connections and hardware necessary for a complete high mast lighting unit.

K High Mast Lighting Unit Testing

Test each completed high mast lighting unit by fully raising, latching, unlatching, and fully lowering the luminaire ring assembly at least 2 times. After each raising and lowering sequence the district traffic office will inspect the following;

(1) Winch and power unit
(2) Winch and supporting cables
(3) Power cable
(4) Luminaire ring assembly
(5) Latching system

Stop the test if problems or failures occur. After the problem or failure has been corrected the test will be repeated in full.

Untwist twisted cables and ensure cables are wound evenly on the drums before each raising and lowering sequence.

Ensure cables are wound evenly on the drums, and the luminaire ring is fully raised, latched, and level after the test has been completed.

SL-1.3 MEASUREMENTS

A Piling

The CIP Concrete Piling 12 “or Steel H-Piling piling is measured for payment by the length of acceptable piling below cut-off.

Piling is paid for by the linear foot and payment made for the actual number of linear feet of acceptable piling complete in place as needed for the design.

No additional payment will be made if the Contractor chooses to provide and drive thicker wall CIP piling than specified.

The cost of mobilization and demobilization for pile driving operations is included in the cost of mobilization and demobilization in accordance with 2452.5, "Basis of Payment".

The cost to control sediment in water from jetting operations is included in the cost of piling.

SL-1.4 BASIS OF PAYMENT

A Piling

Piling is paid for by the linear foot and payment made for the actual number of linear feet of acceptable piling complete in place as needed for the design.

(1) CIP Concrete Piling is paid for under Pay Item No. 2452.603 (C-I-P CONCRETE PILING 12”) at the Contract unit price per LINEAR FOOT, which price is compensation in full.

(2) Steel H piling Contract is paid for under Pay Item No. 2452.603 (STEEL H-PILING 10 INCHES) at the Contract unit price per LINEAR FOOT, which price is compensation in full.