

**CHAPTER 17 – SIGNAL HEADS AND ROADWAY LUMINAIRES**

**SIGNAL HEADS AND LUMINAIRES**

The standards and requirements for signal heads and luminaires are presented in this chapter.

**17.1 Signal Heads**

**17.1.1 GENERAL REQUIREMENTS**

All signal housings and pedestrian signal housings must be black polycarbonate housings. Standard ITE vehicle signal heads must utilize light emitting diodes (LED) units. The vehicle signal housings and LED indications must be listed on MnDOT’s Approved/Qualified Products List (APL) for signals. All signal heads furnished at one intersection must be made by the same manufacturer. The LED signal indication must operate on a nominal 120 VAC power source. The contractor must apply a label in accordance with Specification 2565.3L.6 showing the month and year the indication was installed.

A back plate (or background shield) must be dull non-reflective black with a rolled outer edge and attached to a vehicle signal head as specified in the contract documents. The background shield that is attached to a vehicle signal head mounted directly above a pedestrian signal head must not be cut.

The visors must be of the tunnel type, finished dull non-reflective black and enclose approximately 80 percent of the lens circumference. A terminal block must be provided and securely fastened to the inside of one of the signal housings for connecting the conductors. The conductors from each indication must be run independently to the terminal block and must not be bound together into a cable. The conductors must not be spliced from the signal indication to the terminal block in the signal head.

For vertically mounted terminal blocks termination of the signal control cable running from the pole base into signal head shall be terminated with the spade lug mounted horizontally and a loop of wire extending up from the terminal block at least three inches above the block and then a loop back down to exit the signal head for termination in the pole base.

For horizontally mounted terminal blocks termination of the signal control cable running from the pole base into signal head shall be terminated with the forks of the spade lug pointing down.

After the conductors have been properly terminated the entire terminal block and the spade lugs shall be sprayed with a MnDOT approved pole base terminal block coating as listed on MnDOT’s APL.



Figure 17-1: Poly-Carbonate Signal Heads



Figure 17-2: Signal Head Labels



Figure 17-3: Background Shield with Pedestrian Signal



Figure 17-4: Vertically Mounted Block

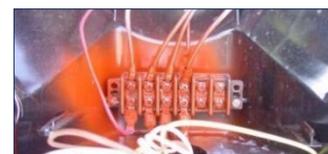


Figure 17-5: Horizontal Terminal Block

**17.1.2 EXISTING TRAFFIC CONTROL SIGNAL SYSTEM**

When pole mounted signal heads utilizing bracketing are mounted on the mast arm pole, they must utilize a 1 1/2-inch half coupling that is welded to the mast arm pole shaft (one on each side), 10 feet above the pole foundation. The supporting pipe may utilize a three-piece coupling between the signal head and the pole shaft.



Figure 17-6: Coupling

A support pipe, with an ornamental pole clamp, must be installed on the top of the pole. The clamp must be fastened to the shaft with 3/4-inch stainless steel banding and clip.



Figure 17-7: Support Pipe

If a pedestrian signal head is mounted with bracketing on the bottom side of the signal head a cross fitting and another supporting pipe with tee and ornamental pole clamp must be used and the clamp banded to the shaft.

**17.1.3 NEW TRAFFIC CONTROL SIGNAL SYSTEM**

New traffic control signal systems will require that the contractor furnish and install angle mounts for the installation of vehicle and pedestrian signal heads on mast arm pole standards. When installing cluster head assemblies on poles, the extended threaded pole adaptor must be used. Additionally, the ball and socket must be adjusted with little or no gap on the back side to allow the background shield to clear the pole.

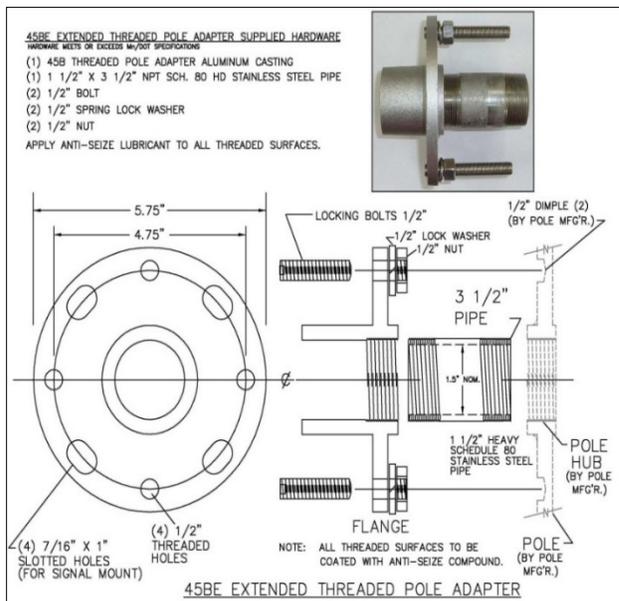


Figure 17-8: Extended Threaded Pole Adapter



Figure 17-9: Cluster Head Installation

New traffic control signal systems require the contractor to furnish and install straight mounts for the installation of vehicle and pedestrian signal heads onto pedestal shafts. The straight mount manufacturer ships threaded inserts (rivet nuts) with each bolt on hub and flange which is used to attach the straight mount to the pedestal shaft. The contractor must use a manufacturer's specific threaded insert (rivet nut) installation tool (see Figure 17-9) to properly fasten the devices into the pedestal shaft.

Angle and straight mounts must be MnDOT approved and listed on MnDOT's APL for signals. Contract documents for new traffic control signal systems include details for installing one way mounts onto mast arm pole standards and pedestal shafts.

All wiring must be internal to the straight or angle mounts, the signal bracketing pipes, and signal heads, and the wires must terminate on the terminal block provided inside the pedestrian or signal head.

Signal head mounting spacers must be used when installing four or five section signal indications.



*Figure 17-10: Installation on Pedestal Shaft*



*Figure 17-11: Rivet Nut for Pedestal Shaft Straight Mount*

**11F SPACER SUPPLIED HARDWARE**  
INDICATE SIZE OF HARDWARE IN YOUR SPECIFICATIONS

11F SPACER CASTING  
(1) 1/4" X 3" BOLT  
(2) 1/4" FLAT WASHER  
(1) 1/4" LOCK NUT  
APPLY ANTI-SEIZE LUBRICANT TO ALL THREADED SURFACES.

HOLE OFF CENTER FOR ROTATION

(1) 1/4" X 3" BOLT

3/8" HOLE

1 1/2"

(2) FLAT WASHERS

LOCK NUT

**11F Spacer**

**TOP VIEW**

SIGNAL

SIGNAL MOUNT

11F SPACER (2) REQUIRED

ROTATE TO BEST POSITION BETWEEN SIGNALS. ATTACH USING SUPPLIED HARDWARE, TWO REQUIRED PER MOUNT. CASTING CAN BE INVERTED.

SIGNAL

11F Spacer Installed

11F Spacers allow three point stress relief for mounting signals horizontally, or for plastic vehicle signals.

NOT TO SCALE

**NOTES:**

- RECOMMENDED FOR 4 AND 5 SECTION PLASTIC SIGNAL ARRANGEMENTS.
- TWO (2) 11F SPACERS ARE REQUIRED PER Mn/DOT SPECIFICATIONS FOR 4 AND 5 SECTION PLASTIC SIGNAL ARRANGEMENTS.
- SPECIFIC JOB SPECIFICATIONS MAY REQUIRE THEM ON ALL PLASTIC SIGNAL VEHICLE ARRANGEMENTS.

11F SPACER			
REVISION DATE	Frey Manufacturing Corporation	DWG NO.	REV
02-09-09	13150 STEWART AVE., NORWOOD, MN 55368-9675	5A	1
	VOICE/FAX 952-467-4402		

Figure 17-12: Signal Head Mounting Spacer Instructions



Figure 17-13: Rivet Nut Installation Tool

### 17.1.4 MAST ARM MOUNTED HEADS

Signal heads mounted on the mast arm must have two indications mounted below the one-way mount and the rest above. For example, in a four section (FYA) head, two indications are mounted below the one-way mount and two above it. The contractor must utilize signal head mounting spacers as specified in the contract.

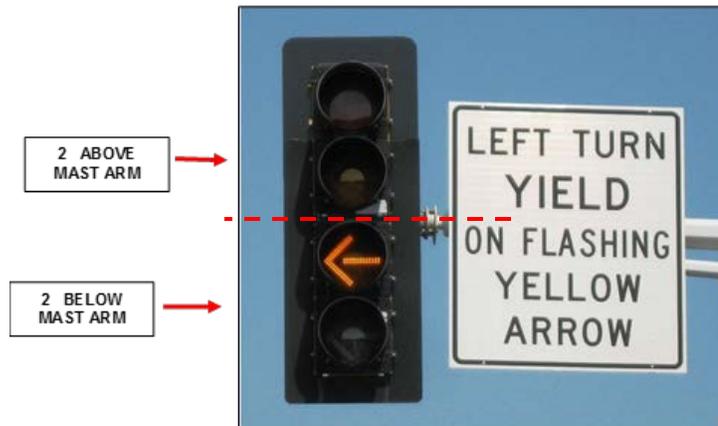


Figure 17-14: Signal Installation on Mast Arm

The signal heads are fastened to the mast arm mounting flange and the straight mount is bolted to the mast arm as indicated in the contract documents.

All vehicle and pedestrian signal heads must be bagged immediately after installation and must remain so until the traffic control signal system is placed into operation.

The access openings are located on the back side of the vertical mast arm pole, backside of the luminaire extension, under the mast arm truss near the point of attachment of the mast arm, and back side of truss at each mid-arm location to facilitate pulling the wires from the signal heads mounted on the mast arm. All wiring must be internal to the mast arm and terminated on the terminal blocks in the signal heads.

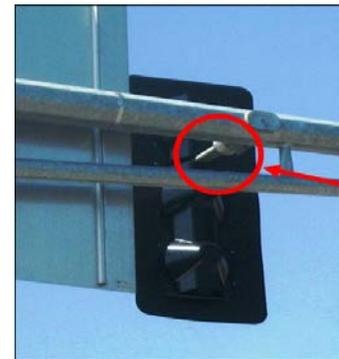


Figure 17-15: Mast Arm Straight Mount



Figure 17-16: Vertical Mast Arm Access Openings



Figure 17-17: Mast Arm Truss Access Openings

### 17.1.5 PEDESTAL MOUNTED HEADS

A traffic control signal pedestal consists of the base, the shaft, slipfitter collar (bracket systems), re-enforcing collar, and appropriate signal heads.

On pedestal installations with bracketing, a slipfitter collar is mounted on top of the shaft so that bracketing pipes can be threaded into it and allows the mounting of any variety of signal heads. All signal brackets and pipe fittings must be mounted plumb and level.

Aiming signal heads must be done in the presence of the district traffic office representative when the signal is flashing. This requires two people; one person must stand at the location from which the indications are to be seen and direct the second person adjusting the signal heads. Signal heads must be made plumb in all directions.



Figure 17-18: Pedestal Installation



Figure 17-19: Slipfitter Collar



Figure 17-20: Aiming Signal Heads

### 17.1.6 PEDESTRIAN SIGNAL HEADS

Pedestrian signal housings must be black poly-carbonate. Pedestrian signal indications and housings must be furnished and installed as specified in the contract documents and operate on nominal 120 volts. The signal heads must be the adjustable type that can be rotated 360 degrees about its vertical axis.



Figure 17-21: Pedestrian Signal Indications with Countdown Timers

Nominal 16 inch by 18 inch LED pedestrian signal indications with countdown timer must be furnished by the contractor as specified in the contract documents. All pedestrian signal indications with countdown timers must be on MnDOT’s APL for signals as indicated in the contract documents.

**17.1.7 RAMP METERS**

Unless otherwise specified in the contract documents ramp meters must have nominal 8-inch LED indications. The visors must be of the cutaway type.



Figure 17-22: Ramp Meter Signal Pole

**17.1.8 FLASHING YELLOW ARROW SIGNAL HEAD**

MnDOT is now installing the flashing yellow arrow traffic control signal head at signalized intersections throughout the state. When operated correctly, the flashing yellow arrow signal will make traffic control signals more efficient without compromising safety.

**Installation**

Flashing yellow arrow signal heads must have two sections mounted above the mast arm and two sections mounted below the mast arm. The R10-X12 flashing yellow arrow sign is also required on MnDOT installations.

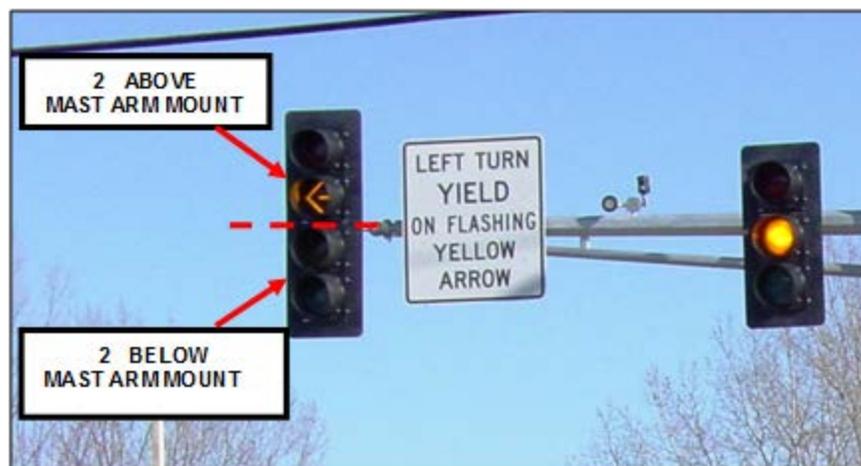


Figure 17-23: Yellow Flashing Arrow Signal Head Installation

In some FYA applications where the lane is striped for both a through movement and a left turn, a cluster mount (dog house) style signal head configuration is used. An approved cluster mount adaptor is listed on MnDOT's APL for signals.

This signal head configuration also requires a bi-modal indication. This signal indication has both a green and yellow arrow with a clear lens. Approved bi-modal indications are listed on MnDOT's APL for signals. Bi-modal indications are approved for use in this specific application only.

The signal head configuration in Figure 17-21 is a five section 6-indication type. The bi-modal indication provides the solid green arrow and flashing yellow arrow indication.



Figure 17-24: Bi-Modal Indication

## 17.2 Luminaires

All LED Luminaires listed on MnDOT's APL have a minimum ten-year warranty. These luminaires will operate in a range of 120 - 277 VAC (rms) with an integral power supply, pre-wired in the factory with terminal blocks or color-coded pigtails for field connections. All MnDOT approved luminaires must have an ANSI C136.41-2013 standard 7-terminal twist-lock type photoelectric control mounting receptacle with shorting cap and a dimmable electronic driver (power supply). MnDOT approved luminaires are listed on MnDOT's APL for roadway lighting.

### 17.2.1 LED ROADWAY LUMINAIRES

#### 40-Foot Mounting Height

LED luminaires for mounting at 40 feet are replacements for the existing 250 watt HPS luminaire. The housing must be adaptable to the nominal 2 3/8-inch diameter tenon on the end of the luminaire mast arm. This class of LED luminaire is used in both lighting and at traffic control signal systems.

#### 49-Foot Mounting Height

LED luminaires for mounting at 49 feet are replacements for the existing 400 watt HPS luminaire. The housing must be adaptable to the nominal 2 3/8-inch diameter tenon on the end of the luminaire mast arm.



Figure 17-25: LED Luminaire

### 17.2.2 LED REPLACEMENTS FOR VERTICAL MOUNT

LED replacements for vertical mount luminaires (250 and 400 HPS luminaires) are the approved "LED Luminaires for Roadway Use Mounted at 49 Feet" found on MnDOT's APL for Roadway lighting. 90 degree tenon mount adaptors found MnDOT's APL for Roadway lighting are required when installing the luminaires on vertical mount poles.



Figure 17-26: Luminaire with 90 Degree Vertical Mount Adaptor

### 17.2.3 LED UNDERPASS LUMINAIRES

LED underpass luminaires are replacements for 250-watt high pressure sodium luminaires. The housing of the luminaire is anodized aluminum.

Underpass luminaires are usually installed on the abutment of a bridge or on a pier a minimum of 17 feet above the traveled roadway. If such mounting would place a luminaire more than about 20 feet from the edge of the traveled roadway, the luminaire is usually mounted on a metal mounting bracket bolted under the bridge deck.



Figure 17-27: LED Underpass Luminaire

Bird spikes are now required to be installed on underpass luminaires. A full-size instruction sheet can be found in the Appendix.

### 17.2.4 LED LUMINAIRES ON SIGNAL POLES (40-FOOT)

Luminaires are mounted on signal poles to provide intersection illumination. They are LED luminaires found on MnDOT's APL under LED roadway luminaires for mounting at 40 feet.



Figure 17-28: Luminaire Mounted on Signal Pole

### 17.2.5 HIGH MAST LUMINAIRES (TOWER LIGHTS)

High mast luminaires have a symmetrical or asymmetrical light pattern on the ground below the tower. High mast luminaires must be MnDOT approved luminaires as listed on MnDOT's APL for roadway lighting.



Figure 17-29: LED High Mast Luminaire

### 17.2.6 LUMINAIRE INSTALLATION

Install and level luminaires in accordance with MnDOT 2545.3Q, the manufacturer's installation requirements and to the satisfaction of the engineer.

Luminaires need to be installed in accordance with manufacturer's installation requirements. Tightening of the bolts that hold the luminaire on the tenon have specific tightening torque requirements that must be followed. Over tightening of these bolts can cause damage to the luminaire or the tenon.

Place a level on the area provided on the top of the luminaire, and level side to side and front to back direction. Adjust the luminaire as required to completely level the luminaires. Luminaires must be level in order to perform properly.



Figure 17-30: Luminaire Leveling

### 17.2.7 LIGHTING CONTROLS

Lighting controls (smart photocontrols) are available when installing LED luminaires. MnDOT luminaires come standard with a seven pin photocontrol receptacle with shorting cap and a dimmable electronic driver (power supply). These features make the luminaires lighting controls ready by simply replacing the shorting cap with a smart photocontrol.

On some MnDOT roadway lighting projects smart photocontrols may be required. The Department may supply the smart photocontrols to the contractor for installation on the luminaire prior to the luminaire being installed on the pole. Refer to the project's special provisions.



Figure 17-31: Smart Photocontrol

It is important that the photocontrol window be faced north as required by the manufacturer. If a north facing node is not achievable then facing east or west is an acceptable alternative.

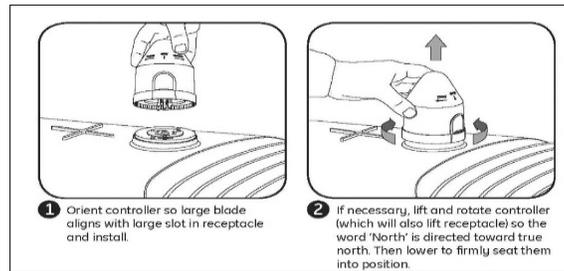


Figure 17-32: Instructions for North Facing Node

Lighting control systems monitor and provide the following:

- Energy measurement at revenue grade per luminaire
- Luminaire voltage
- Luminaire wattage
- Luminaire type LED
- Luminaire dimming (0 to 10 volts)
- Dayburner
- No communication
- Global Positioning System (GPS) location

Smart photocontrols are not listed on the MnDOT's APL for roadway lighting. There is a state contract in place where CPV members can purchase smart lighting controls.

A modification in the lighting service cabinet will be required when lighting controls are installed. The contactor must be bypassed and de-energized. The luminaire and pole wiring will be energized 24 hours a day. Continuous powering of the lighting control allows the lighting control and the luminaire to report their status 24 hours a day 7 days a week.



Figure 17-33: Modified Lighting Cabinet. Contactor Bypassed

Since luminaires and wiring in the light pole bases will be energized 24 hours a day, a "Hazardous Voltage" warning label will be placed on light poles and on the lighting service cabinet. Refer to the special provisions for the project on how to procure and apply the warning labels.



Figure 17-34: Hazardous Voltage Warning Label

### 17.2.8 AIR OBSTRUCTION LIGHTS (3816)

MnDOT has LED air obstruction lights listed on MnDOT's APL for roadway lighting.

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

MnDOT approved air obstruction lights include infrared light to aid pilots using night vision goggles.

#### **Installation**

When the project requires air obstruction lights be installed on a roadway light pole the plans and special provisions will require each pole requiring air obstruction lights to have a 3/4-inch (N.P.T.) nipple welded to the horizontal portion of the light pole facing skyward. Three conductor 14 AWG signal control cable must be pulled up from the pole base to the air obstruction light in addition to the required 12- 2 UF with ground luminaire conductors. A separate breakaway fuse holder will be required in the pole base for the air obstruction light.



Figure 17-35: Air Obstruction Light

### 17.2.9 NAVIGATION LANTERNS (3817)

MnDOT has LED navigation lanterns listed on MnDOT's APL for roadway lighting.

#### **Installation**

Install navigation lanterns in accordance with contract documents.



Figure 17-36: Navigation Lantern

### 17.2.10 LUMINAIRE LABELING

LED roadway luminaires require two types of labels be added by the contractor. One label defines the name of the luminaire or (MnDOT mounting height in feet 40 or 49) for the luminaire, the other is the date the luminaire was installed... The labels can be found on the MnDOT APL for lighting.

Affix a machine printed label showing the month and year the LED luminaire was installed. Two of these labels are required, one on the outside of the luminaire facing the ground and one on the inside of the luminaire.

LED underpass luminaires do not require a mounting height label be applied however the installation date label and the light unit number are required.

MnDOT approved labels are listed on MnDOT's APL for roadway lighting.

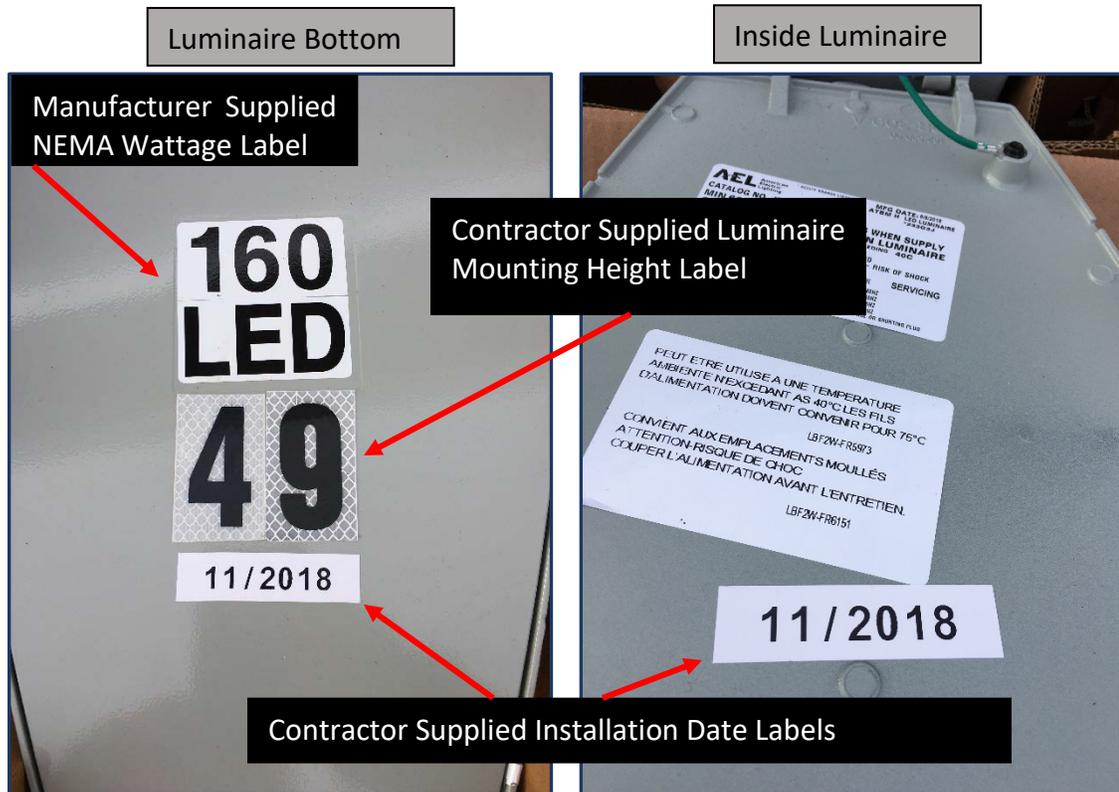


Figure 17-37: Required Luminaire Labels

### 17.3 Chapter 17 Resources

- MnDOT's Approved/Qualified Products List
- MnDOT Standard Specifications for Construction 2565.3L.6, 3816, 3817

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