CHAPTER 16 – SIGNAL AND LIGHT POLES

SIGNAL AND LIGHT POLES
The standards and requirements for installing traffic control signal and light poles are presented in this chapter.

16.1 Traffic Control Signal Poles

16.1.1 MAST ARM POLES AND PEDESTALS

Mast Arm Poles
A PA traffic control signal pole consists of a transformer base, a vertical pole shaft, a mast arm truss, and where applicable, a luminaire shaft extension.

The PA pole is a 21-foot high tapered octagonal pole shaft. There are three pole types; the PA 85, PA 90, and the PA 100.

The tapered octagonal mast arm truss is attached to the top of the shaft. The mast arm consists of an upper and lower chord braced together to form a truss. The length of the mast arm trusses ranges from 15 – 55 feet depending on the PA pole type.

A BA traffic control signal pole consists of a vertical pole shaft, a mast arm truss, and where applicable, a luminaire extension shaft. The BA pole does not use a transformer base. Instead, a 10-inch by 12-inch access opening is provided in the pole shaft to access the wiring.

The BA pole is a 21-foot 10-inch high round shaft. There are five pole types; the BA 60, BA 65, BA 70, BA 75, and the BA 80.

The round tapered mast arm truss is attached to the top of the shaft. The mast arm consists of an upper and lower chord braced together to form a truss. The length of the mast arm trusses ranges from 60 - 80 feet depending on the BA pole type.

If required in the contract documents, a luminaire shaft extension is installed atop the signal pole shaft. Luminaires mounted on the shaft extension tenons are typically 40 feet above the roadway.
If required by the contract documents, swing away hinges must be installed on the mast arm. The hinges must be installed in such a manner that the mast arm swings away from the intersection.

Swing away hinges are used for traffic control signal systems that are located on house moving routes.

Before the project begins, the contractor must furnish to the engineer, for approval, four complete sets of shop drawings as specified in the contract documents.

The drawings must indicate all member materials and dimensions, section modules of the main component parts, and other pertinent data and calculations.

If approved by the engineer, one set of drawings must be distributed as specified in the contract documents.
Mast Arm Pole Installation
Mast arm poles are plumbed by using the leveling nuts on the foundation anchor rods.

Poles must be carefully hoisted into position to avoid damage to the finish. Damaged areas must be repaired as specified in the contract documents.

The access door of the transformer base must be oriented away from the traffic, as specified in the contract documents, to allow service personnel to see the intersection while servicing the base.

The mast arm pole standard must be installed and tightened on the concrete foundation anchor rods as specified in the installation procedure as detailed in the contract documents.

After all mast arm pole standard wiring is complete, the access opening covers (see Figure 16-5) must be sealed with 100% clear silicone sealant at final installation.
**Pedestals**

Pedestal shafts and bases must be unpainted anodized aluminum, unless otherwise specified in the contract documents.

Pedestals consist of a shaft and a base. The base is designed to break away from the foundation when struck by a vehicle. A re-enforcing collar (wind collar) or a base with an extended neck and set screws is required with each pedestal installation.

If steel pedestal shafts are specified, the steel shaft must be constructed of a welded 4-1/2 inch outside diameter steel tubing and a threaded 5-inch-long, 4-inch standard steel pipe nipple. The nipple is welded to the end of the steel tube and must follow American Welding Society requirements. See Standard Plate 8122 for all requirements.

Apply anti-seize compound to all threaded surfaces including set screws, door access bolt, and pedestal shaft.

The contract documents may require pedestal shafts and bases to be painted. All painting of pedestal shafts and bases must be in accordance with the contract documents. Pre-painted pedestal shafts and bases that have scratches or other type of damage will not be accepted.

The pedestal base must have a threaded top and square transformer base design. For steel pedestal shafts, a 4-inch threaded steel pipe nipple must mate with the pedestal base.

Four new anchor rods, with washers, and nuts must be furnished with each pedestal base.

The pedestal base access door must provide a positive closure with a fixed catch on the inside bottom of the door and a bolt type locking mechanism on the top. Anti-seize compound must be applied to the threads of the stainless-steel hex-head bolt.
As shown in Figure 16-11, one NRTL listed ground lug wire connector must be mounted with a single bolt on the sidewall, 3 inches from the door and 8 inches above the bottom of the base. The connector must accommodate a 6 AWG copper ground wire and must have a slot head screw to connect the ground wire.

**Pedestal Installation**

The pedestal foundations must be installed as required by the contract documents. The pedestal base must be secured to anchorages of the concrete foundations or screw-in steel foundations utilizing nuts and washers as specified in the contract documents.

The contract documents for each traffic control signal system project will dictate whether a pedestal concrete foundation or a pedestal screw-in foundation is to be installed by the contractor.

The pedestal base must be plumbed with galvanized steel shims only.

See Standard Plate 8129 for additional requirements.
The access door of the base must be oriented away from traffic to allow maintenance personnel to see the intersection while servicing the base.

As shown in Figure 16-16, pedestal caps must be either steel or anodized cast aluminum based on the material of the pedestal shaft. The pedestal cap must be the same color as the pedestal shaft.

16.2 Light Poles

MnDOT light poles:

2. If providing breakaway poles, the poles must be certified from the manufacturer that the pole meets specifications as specified in the current edition of AASHTO Standard Specifications of Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
3. Must have a nominal 2 3/8-inch schedule 40 tenon for slip fit luminaire installation.
4. Davit or mast arm must have an upward angle from horizontal of 3 degrees +/- 2 degrees.

There are several types of light poles MnDOT uses. The most common types of poles used on MnDOT lighting systems are:

- Stainless steel 40-foot and 49-foot breakaway
- Aluminum alloy 40-foot and 49-foot breakaway
- Coated (galvanized) steel bridge and barrier 40-foot and 49-foot nominal height non-breakaway
- High mast light towers
16.2.1 DEFINITION AND OVERVIEW

A lighting unit is defined as follows:

A lighting unit includes the light pole, internal wiring with fuse holder and fuse to the luminaire, above ground splices, wire holder, stainless steel woven wire cloth, and luminaire. Underpass luminaires are lighting units even though they do not include some of these components. The foundation is not considered as part of this definition.

The type of light pole required for each project will be shown in contract documents.

Light poles that are specified by MnDOT are fabricated from stainless steel, high strength steel, or aluminum.

Light poles fabricated from aluminum must have a factory installed vibration dampener.

Light poles must be fabricated in accordance with MnDOT 3811.

Within 15 days after the contract approval notice mailing date, the contractor must furnish evidence to the engineer, in writing, that orders have been placed for all components of the lighting units required for the project.

The contractor must submit to the engineer, for approval by the district’s traffic engineer, sets of prints of required shop detail drawings of the light poles and anchor rods, in accordance with 2471.3.B. For high mast lighting installations, the contractor must submit final reproducible drawings in accordance with 2471.3.B. The drawings must be distributed after approval, to the following:

1. Contractor’s fabricator
2. Contractor
3. Engineer
4. District traffic engineer

All light poles must be approved before installation.

The Engineer’s acceptance of shop drawings will not relieve the contractor of full responsibility for submission of complete and accurate drawings and for the accurate assembly and fitting of all structural members.
16.2.2 TYPES OF LIGHT POLES

**Stainless Steel 40-Foot and 50-Foot Breakaway**

Stainless Steel Pole:

- Slip fit high base
- 16 sided
- Typically single davit (6 feet - 12 feet)
- Mounts on Design E and H foundations
- Can be double davit in areas such as gores

**Aluminum Alloy 40-Foot and 49-Foot Breakaway**

Aluminum Alloy Pole:

- Transformer base (bolt on)
- Typically single davit (6 feet - 12 feet)
- Mounts on Design E and H foundations
- Can be double davit in areas such as gores

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Figure 16-17: Stainless Steel Breakaway

Figure 16-18: Aluminum Alloy Breakaway
**Bridge and Barrier Poles 40-Foot and 49-Foot**

- Galvanized steel
- Non-breakaway
- High base
- 6-bolt base plate
- Two access door assembly
- Single and double davit
- Mounted on barrier (center median and bridge barrier foundations)

![Figure 16-19: Bridge and Barrier Poles](image)

**High Mast Light Towers**

- COR-TEN steel (weathering steel)
- High base design
- Typically 100 feet or 120 feet
- Typically ring assembly holds 3 to 4 luminaires

![Figure 16-20: High Mast Tower](image)
16.3 Installation for Signal and Light Poles

16.3.1 ANCHOR ROD CONSIDERATIONS

The anchor rod connection is a critical component of foundations and pole structures. The primary functions of anchor rod connections are to attach a pole to a foundation and safely transmit loads from the pole into the foundation. Failure of anchor rod connections could lead to collapse of the pole. Therefore, it is imperative to follow the installation instructions and requirements in accordance with the pole manufacturer, the current edition of AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, and MnDOT contract documents.

Lift and safely move poles without damage. Avoid abrasion during lifting operations. Do not drag the poles on the ground and use natural or synthetic fiber slings and chokers for lifting. Protect the pole finish from coming in direct contact with the ground surface and metal hardware used for lifting and rigging. Repair any finish surface damage in accordance with the manufacturer’s requirements.

Before standing poles on foundations:

1. Verify the anchor rod pattern matches the base plate hole pattern.
2. Verify the required anchor rod grade by locating the steel die stamped grade identification on the end of the anchor rod projecting above the concrete.
3. Verify anchor rods meet projections for a properly secured pole, and meet AASHTO stub height requirements when breakaway is required.
4. Verify anchor rods are clean, not damaged, and plumb.
5. Verify nuts can be turned down on the anchor rods to the foundation and backed off by hand or by one worker using an ordinary wrench without a cheater bar.
6. Verify the base plate opening accommodates conduits and ground rod electrodes.
7. Ensure the pole is free of dirt or other foreign material, and
8. Inspect poles for damage.

As shown in Figure 16-21 and 16-22, clean and brush on an anti-seize and lubricating compound referred to as “bridge grease” to the exposed threads of all anchor rods (bolts) and nuts and the bearing surface of all nuts and washers just before installing signal service cabinets, mast arm poles, pedestals, light poles, lighting service cabinets, or other types of structures on anchor rods.

Bearing surface means the plane of contact between the washer and the nut or bolt head being turned when tightening the anchor rod (bolt) connection. Up to 70% of the friction of an anchor rod connection comes from turning the nut against the washer.
Use bridge grease on bearing surfaces and threads of nuts and anchor rods to reduce friction when tightening the connection.

Ensure a clean work area to prevent dirt from contaminating bridge grease on nuts, washers, and anchor rods. Contaminants will cause friction between the anchor rod and nut and therefore impede nut rotation to achieve proper tightening of the connection.

Clean anchor rods, nuts and washers and re-apply bridge grease if more than 24 hours has passed since earlier application or the anchor rods, nuts, or washers have become wet after applying bridge grease.

**Installation Procedures**

To install anchor rods, use fixed-sized wrenches designed to tighten nuts on anchor rods such as open-end wrenches, closed end or box end wrenches, combination wrenches, slugging wrenches, iron workers spud wrenches, or socket wrenches sized specifically for turning nuts. Do not use pipe wrenches and adjustable type wrenches for tightening anchor connections.

Pipe wrenches are used in plumbing for gripping round cylindrical things like threaded pipe to tighten and loosen. Do not use pipe wrenches for tightening nuts on anchor rods.
Anchor Rod Securement

Ensure the top of the anchor rod extends at least one thread beyond the top surface of the top nut. An anchor rod end inside the top nut where no threads extend beyond the top surface of the nut and the top nut is not fully engaged on the anchor rod after tightening is not acceptable.

Place nuts, washers, and pole base plate on the anchor rods in the installation order required by the manufacturer and contract documents. Do not remove required nuts or washers from the connection. Do not add extra washers or additional hardware to the anchor rod connection.

MnDOT anchor rod connections used to attach stainless steel light poles and signal poles to foundations are a typical double-nut connection. In this connection, there are top nuts and leveling nuts that sandwich the base plate.

Aluminum light poles and signal pedestal use a single-nut connection may be used to attach the pole to the foundation. In this connection, the base plate rests directly on the foundation and top nuts are used to tighten the anchor rod connections.

Use the anchor rod connection required by the pole manufacturer.

Follow the standoff distances required by the pole manufacturer when installing double-nut connections. If no standoff distance is provided by the manufacturer, use the AASHTO recommended standoff distance of less than one bolt diameter. Standoff distance is defined as the clear distance between the bottom of the leveling nut and the top of the concrete for double-nut anchor rod connections.

Use hardened flat washers under the nuts being turned for tightening in the anchor rod connection unless the manufacturer does not specify it in their installation instructions. For example, the manufacturer for the cast aluminum frangible transformer base does not require a hardened flat washer under the top nut being turned.

Do not use lock washers in anchor bolt connections unless otherwise indicated by the manufacturer.

Tighten anchor rod connections to full tension as required by the manufacturer and the contract immediately following placement of the pole on its foundation.
During snug tightening and final tightening turn the nuts in a star tightening or crisscross pattern and in at least two full tightening cycles (passes).

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals defines “snug tight” as the maximum nut rotation resulting from the full effort of one person on a 12-inch-long wrench or equivalent. MnDOT 2402.G.2.c(4) Turn-of-Nut Tightening defines “snug tight” as the minimal use of an impact wrench or the full effort of an adult using an ordinary spud wrench to bring all plies of the connection together in firm contact.

Loose anchor rod connections on traffic signal and light poles can significantly shorten the life of the overall structure (pole and foundation). Following the required anchor rod tightening procedure and construction inspection can help prevent loose anchor rod connections.

16.3.2 TRAFFIC CONTROL SIGNAL MAST ARM POLE INSTALLATION

Install traffic control signal mast arm poles in accordance with the pole manufacturer requirements and the contract.

There is a 1 inch lip or flange that overhangs on the mast arm transformer base. This 1 inch lip partially covers the leveling nuts. If the leveling nuts are set too low on the anchor rods a wrench head will not fit between the top of the foundation and the bottom edge of the 1 inch lip for access to the leveling nut. A wrench must be applied to both the top nuts and the leveling nuts to ensure proper tightening of the anchor rod connections.

The manufacturer recommends a standoff distance of 3/8” to 1/2”. If a wrench cannot be applied onto the leveling nuts set the leveling nuts to the recommended standoff distance. Standoff distance is defined as the clear distance between the bottom of the leveling nut and the top of the concrete for double-nut anchor rod connections.

Follow 2565.3.Q for tightening anchor rod connections on traffic control signal mast arm poles.
16.3.3 ALUMINUM LIGHT POLE AND CAST ALUMINUM FRANGIBLE TRANSFORMER BASE INSTALLATION

Install aluminum light poles with cast aluminum frangible transformer bases in accordance with the pole and base manufacturer’s installation instructions and MnDOT Specification 2545.3.H.

Use shims in accordance with Standard Plate 8129 under the base if leveling is required. Do not use leveling nuts. The top nuts with the required 1/2-inch-thick washers sometimes called “holddown washers” are used to secure the base tightly to the foundation, bringing all the plies of the connection together. This is called a single-nut connection as required by the pole manufacturer.

As shown in Figure 16-4, this particular manufacturer posts the installation instructions on a yellow caution sticker affixed to the back inside wall of every base that is AASHTO approved for breakaway.

![Installation Instructions](image)

Figure 16-31: Installation Instructions
Torque the top nuts (ground mounting nuts) to the proper tightening level specified by the manufacturer. This manufacturer requires a torque value of 150 foot-lbs.

Use a torque wrench that has been recently calibrated to measure torque level and to verify that the manufacturer’s specified torque value has been met.
16.3.4 STAINLESS STEEL LIGHT POLE – 15-INCH DIA BOLT CIRCLE HIGH [H] BASE INSTALLATION

Stainless steel light poles use double-nut anchor rod connections. Install stainless steel light poles in accordance with the pole manufacturer’s installation instructions. Contact the pole manufacturer for their installation instructions sheet. A copy of the manufacturer’s installation sheet can be found in the Appendix.

One half inch thick washers, like those used for aluminum light pole bases, are required by the manufacturer when installing a base for stainless steel light poles with a 15-inch bolt circle (MnDOT Design E Base).

One half inch thick washers are not a hardened washer. Therefore, hardened flat washers are required between the lower leveling nuts and the 1/2-inch-thick washers. The 1 inch flange around the base plate overhangs the lower portion of the anchor rod assemblies covering the leveling nuts. This limits access to utilize a standard open-end wrench and adequately tighten the leveling nuts.

Because of this limited access on the 15-inch bolt circle base 1/2-inch-thick washers are placed directly under the base plate to be used as a spacer. As a result, the leveling nuts are turned further down on the anchor rods providing better access to the leveling nuts with a standard open-end wrench.
Use the anchor rod assembly standoff distances specified in the manufacturer’s installation instructions sheet when installing the leveling nuts.

The 17-inch bolt circle base (MnDOT Design H) for stainless steel light poles does not require 1/2-inch-thick washers to be used. The reason is the heavy hex nut used on a 1 1/4-inch anchor rod is thicker in height than a heavy hex nut used on 1 inch anchor rod for the 15-inch bolt circle base. Therefore, a standard open-end wrench head can be placed on the leveling nut even though the base plate flange partially covers the bottom nut.

Like the 15-inch bolt circle base, use the anchor rod assembly standoff distances specified in the manufacturer’s installation instructions sheet when installing the leveling nuts.

Read carefully and strictly follow the instructions provided on the manufacturer’s installation instructions sheet to ensure adequate tightening of anchor rod connections.

**Figure 16-35**: Stainless Steel Light Pole Installation 17-inch Dia. Bolt Circle High Base

**Figure 16-36**: 17-inch Bolt Circle Base
For both types of bases, the installation steps found on the manufacturer’s installation instructions sheet requires the lower leveling nuts and the top nuts to be tightened to snug tight.

**Specified Wrench Lengths for Snugging**

<table>
<thead>
<tr>
<th>Anchor Rod Diameter, (in)</th>
<th>Anchor Gr. (Yield Stress)</th>
<th>Wrench Length, (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36</td>
<td>55</td>
</tr>
<tr>
<td>0.75</td>
<td></td>
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<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>1.25</td>
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<td></td>
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<tr>
<td>1.5</td>
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<td>**</td>
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<tr>
<td>1.75</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>26</td>
</tr>
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<td>25</td>
<td>39</td>
</tr>
<tr>
<td>2.5</td>
<td>35</td>
<td>53</td>
</tr>
</tbody>
</table>

**Use a 12” or less long wrench to snug tighten nuts, pulling the handle with one arm in one smooth motion.**

Once the lower leveling nuts and top nuts have been brought to snug tight condition as instructed in the manufacturer’s installation instructions, perform final tightening in accordance with MnDOT’s contract documents.

A wrench must be placed on the leveling nuts to turn them to snug tight and to the required rotation for final tightening. **A WRENCH MUST BE APPLIED TO THE LEVELING NUTS!** If the leveling nuts cannot be accessed with a wrench to turn the nuts, then the pole is not installed according to the manufacturer’s installation instructions. Reinstall the light pole and follow the manufacturer’s standoff distances detailed on their installation instructions sheet.

See Appendix for Anchor Rod Tightening Torque and Turns Guide for MnDOT Traffic Signal Light Poles and final nut rotations beyond snug.

**16.3.5 LIGHT SYSTEM COMPONENT LABELING (2545.3.P)**
The contractor must number the light poles or the luminaires when light poles are not required (underpass luminaires, tunnel luminaires, special luminaires, etc.) as specified in contract documents.
MnDOT approved labels are listed on MnDOT’s Approved/Qualified Products List (APL) for roadway lighting.

16.4 Rodent Intrusion Barrier for Traffic Control Signal and Light Poles

16.4.1 TRAFFIC SIGNAL POLES
The contactor must provide stainless steel woven wire cloth as specified in 2545.2.X or an approved rodent intrusion barrier found on MnDOT’s APL in traffic signal pole transformer bases MnDOT Standard Plate No. 8121. The stainless steel woven wire cloth is inserted and wound around the opening at the bottom of the pole transformer base in accordance with 2545.3.W “Rodent Intrusion Barrier”.

Figure 16-37: Lighting Pole Numbering

Figure 16-38: Stainless Steel Woven Wire Cloth
The rodent intrusion barrier found on MnDOT’s APL should be installed according to the manufacturer’s installation instructions. Use 100% silicone sealant to fill voids between the approved barrier and the base plate.

16.4.2 STEEL AND STAINLESS STEEL LIGHT POLES

The contractor must provide a stainless steel woven wire cloth as specified in 2545.2.X or an approved rodent intrusion barrier found on MnDOT’s APL in steel and stainless-steel double-nut connection light pole bases with a 10 ¾ inch diameter base plate opening.

On light pole bases the woven wire cloth should be installed in accordance with 2545.3.W.

The entire stainless steel woven wire cloth assembly must be grounded in accordance with the National Electrical Code (NEC).

The rodent intrusion barrier found on MnDOT’s APL should be installed according to the manufacturer’s installation instructions. Use 100% silicone sealant to fill voids between the approved barrier and the base plate.
16.4.2 Aluminum Poles
For aluminum pole bases do not install stainless steel woven wire cloth. Instead, fill any gaps as a result of using leveling shims that exceed 1/8 in between the foundation and the aluminum pole base with 100% clear silicone sealant. Do not completely seal around the perimeter between the foundation and the aluminum pole base.

Figure 16-42: Aluminum Pole Rodent Intrusion

16.5 Chapter 16 Resources
- MnDOT Standard Specifications for Construction 3811, 2545.3.H, 2471.3, 2565.3.Q, 2545.3, 2545.3.P
- National Electrical Code (NEC).
- Standard Plate 8122, 8129
- AASHTO Standard Specifications of Structural Supports for Highway Signs, Luminaires, and Traffic Signals