

2024 CONSTRUCTION- MATERIALS CONFERENCE



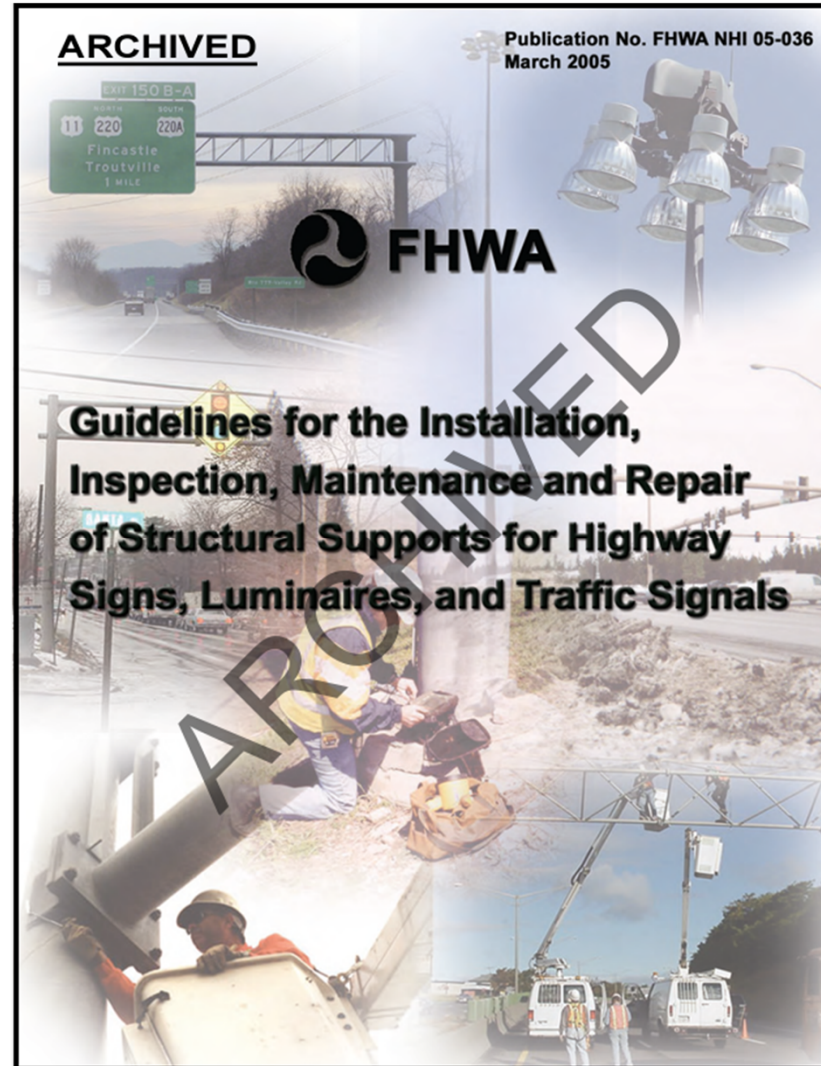
Ancillary Structure
Anchor Bolt Tightening

Ted Whitmore
Traffic Engineering
Division



► OVERHEAD SIGN STRUCTURES, TRAFFIC SIGNAL STRUCTURES, HIGH MAST TOWERS, DMS STRUCTURES

- Revised specifications and a new Materials Procedure put in place for 2023.
- **Revision to Materials Procedure put into place late 2023**
- Process is based on Federal Manual.



► SPECIFICATIONS SECTION 658.5.6.3

- Section 658.5.6.3 covers the erection procedure for ancillary structures and includes the reference to MP 658.05.06
- 658.5.6.3 covers everything except the anchor nut tightening procedure, which is covered in detail by MP 658.05.06

658.5.6.3-Installation Procedure: The following steps shall be followed during the erection procedure:

1. Clean the anchor bolts with a wire brush or equivalent and lubricate the anchor bolts as described herein if this has not already been done.
2. If the structure is to be placed on existing foundation(s) and connected to existing anchor bolts, the Contractor shall verify that it is possible to turn a new properly lubricated nut onto each anchor bolt by hand below the elevation where the leveling nut will be initially placed. If this is not possible, the installation procedure shall be suspended and this issue shall be reported to the Engineer and in turn referred to the Traffic Engineering Division for further direction.
3. Place and level the foundation leveling nuts with washers on top. Initial placement of the leveling nuts shall be no more than ¼-inch above the top of the foundation.
4. Bring the support leg(s) into position for placement. Insure anchor bolts and the bolt holes in base plate are properly aligned. No cold working of the anchor bolts shall be allowed. No cutting or reaming of holes will be allowed without prior approval from the Traffic Engineering Division.
5. Place the support leg(s). The Contractor shall take due care to avoid damaging the anchor bolt threads during this process. If the structure has multiple support legs, one support leg shall be placed and fully tightened into place at a time.
6. With the support leg as plumb as possible, adjust the leveling nuts as needed. The gap between the top of concrete and the bottom of each leveling nut shall not exceed the diameter of the anchor bolt after this process is completed.
7. Fully tighten the anchor bolt top nuts in accordance with Materials Procedure (MP) 658.05.06. The tightening process shall be documented and transmitted to the Traffic Engineering Division in accordance with MP 658.05.06. When the snug tightening portion of MP 658.05.06 is completed, the Contractor shall verify that all nuts and washers were brought into firm contact with the base plate. Beveled washers may be necessary under the leveling or top nut if any face of the base plate has a slope greater than 1:20 and/or any nut could not be brought into firm contact. If it is determined that beveled washers are required, the support leg shall be disassembled from the anchor bolts and the erection procedure shall be restarted using the beveled washers. Beveled washers shall be manufactured of the same material as the base plate and shall be galvanized. Beveled washers shall be square with the length of each side being equal to or greater than the diameter of the normal washers. The minimum thickness of the beveled washers shall be the thickness of the normal washers.
8. Release any load by crane or other erection device. The anchor bolt nuts must be properly tightened before removal of the crane. If problems exist such as the anchor connections are loose after release, then repeat the nut tightening procedure.
9. Lift the structure arms or span into place. The Contractor shall be responsible for determining and selecting appropriate lift points in order to not overstress the structural components or attachments during lifting.
10. Once components that are attached using structural connection bolts are lifted into place and lubrication is applied to the hardware components as required, the bolts shall be snug tightened and then fully tightened immediately. The snug tightening procedure used shall be the same as described for the anchor bolts in MP 658.05.06. The procedure for fully tightening the bolts is described in Section 658.5.6.3.1. Once span structures are lifted into place and proper alignment is verified, they shall be secured to the support legs by installing and tightening the u-bolts immediately.
11. Check structure. If problems exist, such as loose arm connections or showing gaps, the load must be removed from the area in question and steps repeated as necessary. If this requires loosening structural connection bolts that have already been fully tightened, the bolts shall be replaced.
12. If not installed prior to lifting the arms or chords into place (required for box truss spans), all signs to be attached to the structure arms or chords shall be installed immediately after the attachment hardware for the arms or chords are fully tightened.

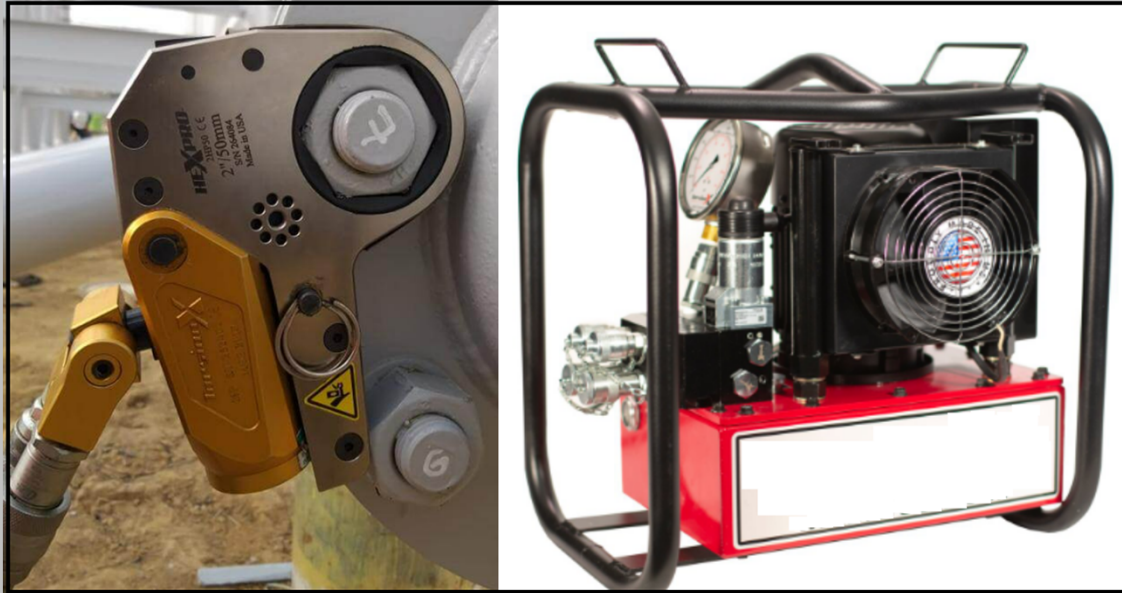
MP 658.05.06

- MP 658.05.06 specifies the required materials and equipment for proper tightening and provides the detailed procedure for performing and documenting the process.

MP 658.05.06 SIGNATURE DATE PAGE 1 OF 6	
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS MATERIALS CONTROL, SOILS & TESTING DIVISION	
MATERIALS PROCEDURE	
ANCILLARY STRUCTURE ANCHOR BOLT TIGHTENING	
1.	PURPOSE
1.1	To establish equipment, procedure, documentation, and documentation transmittal requirements for the tightening of anchor bolt nuts associated with signing, signal, lighting, and intelligent transportation systems (ITS) related roadway ancillary structures.
1.1.1	This Materials Procedure is specifically focused on the procedure to be followed when tightening anchor bolt nuts and does not address all requirements and procedures pertaining to the installation of ancillary structures. Individual component pre-inspection and repair, structure pre-assembly, structure installation preparation, pre-application of protective coatings, overall installation procedure, and proper tightening of structural connection bolts are included as part of the Standard Specifications.
2.	MATERIALS AND EQUIPMENT

MP 658.05.06

- Requires the Contractor to use a hydraulic wrench as part of the tightening process. Contains specific requirements regarding calibration of the wrenches and certificates that the Contractor is to provide.



MP 658.05.06 – ATTACHMENT 2
SIGNATURE DATE
PAGE 3 OF 5

EXAMPLE WRENCH CALIBRATION CERTIFICATE

CERTIFICATE INDICATES LAB IS ISO 17025 ACCREDITED

CERTIFICATE OF CALIBRATION
CERTIFICATE # TW-01193

_____ certifies that the instrument below has been calibrated in accordance with _____ calibration procedures under the conditions noted below using laboratory standards which are traceable to SI units.

The uncertainty represents an expanded uncertainty at approximately the 95% confidence level using a coverage factor of k=2.

The information on this certificate applies only to the identified instrument and may not be reproduced, except in full, without the written consent of _____.

WRENCH MODEL AND SERIAL NUMBER

MODEL	2503MFRMH
SERIAL #	0916506063
TYPE	FLB
CAL DATE	9/2/2021
CAL DUE	9/2/2022
ACCURACY	(+/-) 4%
RANGE MAX	260
RANGE MIN	48

Customer: _____
Address: _____

Tech: _____ Temp (°F) 75.2 RH % 52
Test Method: _____ TI-CAL-1

CALIBRATION DATE

AS FOUND			
PERCENT OF RANGE	WRENCH SETTING	AS FOUND	TOLERANCE
100%	250 FTLB	251.56 FTLB	(+/-) 4%
60%	150 FTLB	147.14 FTLB	(+/-) 4%
20%	50 FTLB	47.596 FTLB	(+/-) 4%

AS LEFT			
PERCENT OF RANGE	WRENCH SETTING	AS LEFT	TOLERANCE
100%	250 FTLB	248.38 FTLB	(+/-) 4%
60%	150 FTLB	147.98 FTLB	(+/-) 4%
20%	50 FTLB	48.286 FTLB	(+/-) 4%

STANDARDS USED FOR CALIBRATION

MODEL USED	MFGR	SERIAL #	CERT #	EXPIRES	RANGE
MTMDP-4L-100	AWS	10963-1	25500-1	7/23/2022	10-100 IN-LBS
MTMDP-4L-500	AWS	10963-2	25501-1	7/23/2022	50-500 IN-LBS
MTMDP-4L-250	AWS	10963-3	25502-1	7/23/2022	25-250 FT-LBS
MTMDP-4L-750	AWS	10963-4	25503-1	7/23/2022	75-750 FT-LBS

Expanded Uncertainty

Range	k=2
10-100 inlb	1.08 inlb
50-500 inlb	4.98 inlb
25-250 ftlb	7.44 ftlb
75-750 ftlb	8.86 ftlb

▶ **MP 658.05.06**

- ▶ **Basic procedure is:**
 - ▶ **Snug tighten top and leveling nuts**
 - ▶ **Place reference marks on the top nuts and base plate**
 - ▶ **Fully tighten the top nuts using turn-of-the-nut procedure (no specific torque value for this step).**
 - ▶ **Apply verification torque to the top nuts.**
 - ▶ **Apply 110% verification torque 48 hrs or more after tightening.**

▶ **Note:**

- ▶ **Snug tightening procedure has been updated. Specific torque values are provided in the MP to achieve snug tight. Specific torque values for the verification torques remain in the MP.**
- ▶ **A torque wrench is required for all steps.**
- ▶ **Pressure/torque calibration charts (if the readout is in pressure) are required for all steps except fully tightening.**

CALIBRATION CHART



ANAB
ACCREDITED
CALIBRATION LABORATORY

Calibration Date:	8/18/2021	Model Number:	3MD
Calibration Due:	2/18/2022	Serial Number:	353228

PSI	FT/LBS	PSI	FT/LBS	PSI	FT/LBS	PSI	FT/LBS	PSI	FT/LBS
100	2	2100	692	4100	1307	6100	1940	8100	2573
200	52	2200	721	4200	1337	6200	1971	8200	2605
300	93	2300	752	4300	1368	6300	2003	8300	2637
400	125	2400	776	4400	1401	6400	2035	8400	2669
500	163	2500	797	4500	1434	6500	2067	8500	2702
600	195	2600	836	4600	1465	6600	2098	8600	2732
700	228	2700	880	4700	1496	6700	2131	8700	2764
800	259	2800	903	4800	1527	6800	2163	8800	2797

Tv = 900 ft-lbs
= 2,787 psi



FIGURE 2 -SNUG TIGHTENING SEQUENCE NUMBERING ON BASE PLATE

Diameter (in.)	Threads/inch	Snug Torque Value (ft-lbf)
1-1/4 (32 mm)	7 (3.629 Pitch in mm)	140 (190 Nm)
1-1/2 (38 mm)	6 (4.233 Pitch in mm)	240 (325 Nm)
1-3/4 (44 mm)	5 (5.080 Pitch in mm)	380 (515 Nm)
2 (51 mm)	4.5 (5.664 Pitch in mm)	570 (775 Nm)
2-1/4 (57 mm)	4.5 (5.664 Pitch in mm)	830 (1125 Nm)

TABLE 1 – SNUG TIGHTENED TORQUE VALUES FOR ASTM F1554 GRADE 55 ANCHORS (CONTACT TRAFFIC ENGINEERING DIVISION FOR ANCHORS OUTSIDE THOSE COVERED BY THIS TABLE)

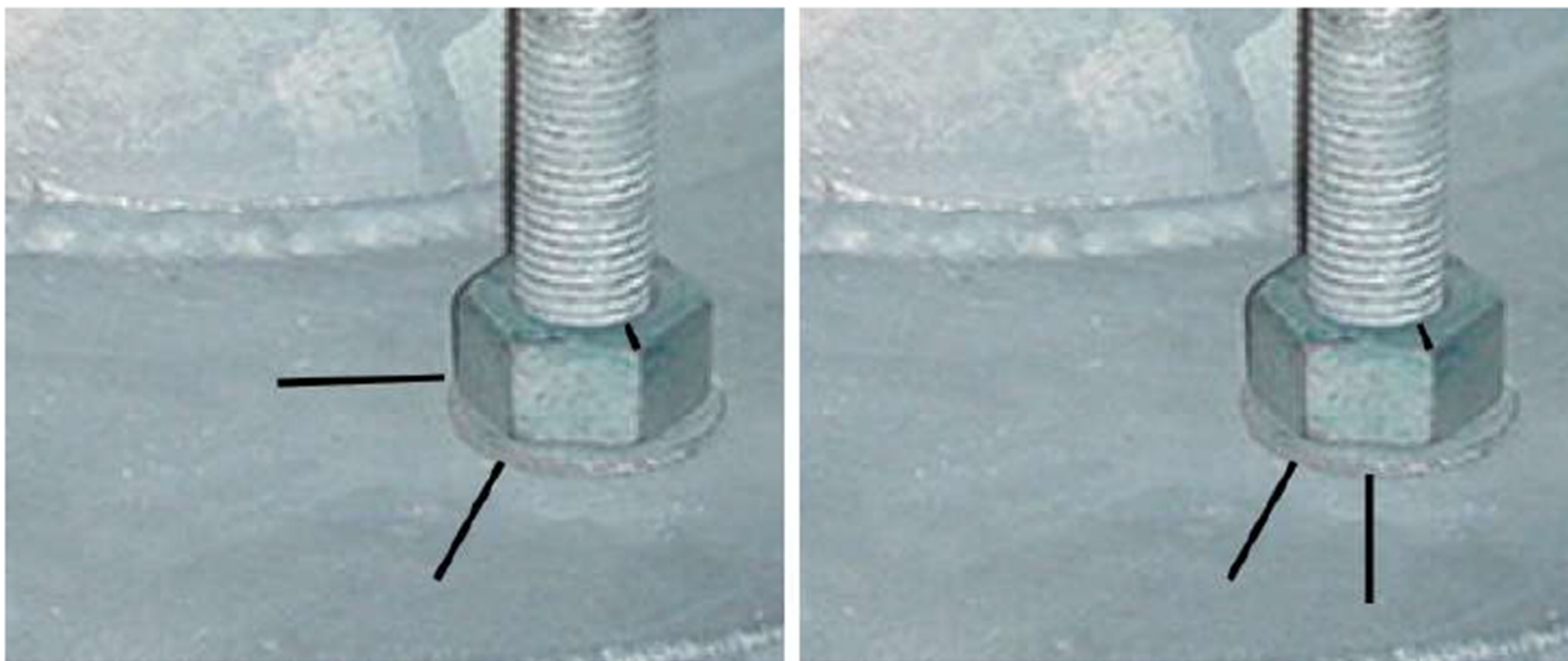


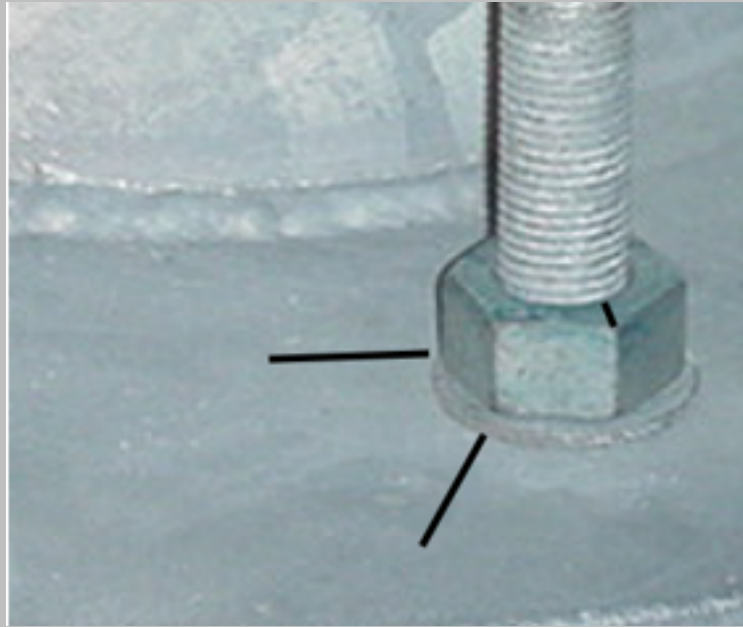
FIGURE 3 - SNUG TIGHT CONDITION REFERENCE MARKS FOR BOLTS 1-1/2" DIAMETER OR LESS (LEFT) AND BOLTS GREATER THAN 1-1/2" DIAMETER (RIGHT)

- Provides form that is to be used to document project info, structure type, tightening equipment, and details of the tightening procedure.

- ## WVDOH ANCILLARY STRUCTURE ANCHOR BOLT TIGHTENING RECORD
- District: _____ State Project Number: _____
Contract ID number: _____ Federal Project Number: _____
Plan Assembly Number: _____
- Structure Utility: ☒ Signing ☐ Signal ☐ Lighting ☐ ITS
Structure Type: ☐ Cantilever ☐ (Sign) Butterfly ☐ (ITS) Butterfly ☒ Span ☐ Strain Pole
☐ Mast Arm ☐ High Mast Tower ☐ Conventional Light Pole
- Anchor Diameter: 2 inches Snug Tight Torque: 570 foot-lbs = 1742 PSI
Tv: 2250 foot-lbs = 7078 PSI
1.10Tv: 2475 foot-lbs = 7787 PSI
- Wrench Serial Number: 0916506063 Gauge Serial Number: 353228
- Diagram of Structure (Plan view of structure showing all base plates. Show and label diagram with base plate numbers and location/position of structure in relation to a reference feature)
- The diagram shows a plan view of the structure's base. Two vertical lines represent the bases, labeled "BASE PLATE 1" on the left and "BASE PLATE 2" on the right. An arrow pointing upwards between them is labeled "TRAFFIC FLOW". An arrow pointing towards the top right from between the plates is labeled "EXIT RAMP".
- Base Plate 1 Diagram (Plan view of base plate with anchor bolt locations. Number anchor bolts the same as the anchors are numbered and tightened. Label diagram to indicate orientation of base plate in relation to a reference feature)
- A square box containing six dots representing anchor bolt locations. The dots are numbered 1 through 6 in a clockwise direction starting from the top-left position.
- RAMP TRAFFIC →**
- Mark Each Box to Indicate Nuts were Numbered and Top and Bottom Nuts were Snug Tightened
- | | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| X | X | X | X | X | X | X | X |
- Mark Each Box to Indicate Nut and Base Plate Indicator Lines were Placed and each Top Nut was Rotated the Number of Required Turns
- | | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| X | X | X | X | X | X | X | X |
- Mark Each Box to Indicate Required Torque to Further Tighten each Top Nut would be at least Tv
- | | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| X | X | X | X | X | X | X | X |
- Mark Each Box to Indicate Required Torque to Further Tighten each Top Nut would be at least 1.10Tv
- | | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| X | X | X | X | X | X | X | X |

MP 658.05.06

- Key points:
 - Make sure Contractor properly lubricates the anchors, washers, and nuts per the Specifications and MP.
 - Make sure Contractor properly marks the nuts and base plate per the MP.



- Inspection personnel should be on hand during tightening to verify the procedure is followed and properly documented.

2024 CONSTRUCTION-MATERIALS CONFERENCE

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