Origination Form

Specifications

Name:	Ben Goldsberry	**Standard Specification Section:**	460
Email:	ben.goldsberry@dot.state.fl.us	**Special Provision:**	
Date:	2025-05-02T19:16:37Z	**Associated Specs:**	962

Summary:

Reference to A490 bolts is being removed from the Specifications. The current language could be misinterpreted to allow A490 bolts using the requirements in Section 460 with the approval of the Engineer. The bolting requirements in Section 460 are explicitly for A325 bolts. A TSP is required for A490 bolts. Terminology updates (primary members, NSTM) are necessary to align with AASHTO. Updating bolt hole geometry to align with AASHTO. Adding edge distance and minimum tension for 1/2-inch bolts. Removing legacy language regarding the definition of a horizontally curved beam or girder (already covered by AASHTO). Section 460-1.2 is removed due to fabricator qualification requirements explained in Materials Manual 11.1 Volume II.

Justification:

To prevent the misuse of A490 bolts and to align Department contract documents with AASHTO policy language.

Do the changes affect other types of specifications?

Neither

List Specifications Affected:

Other Affected Documents/Offices	Contacted	Yes/No
Other Standard Plans		No
Florida Design Manual		No
Structures Manual	Ben Goldsberry	Yes
Basis of Estimates Manual		No
Approved Product List		No
Construction Office		No
Maintenance Office		No
Materials Manual		No

Traffic Engineering Manual		No

Are changes in line with promoting and making progress on improving safety, enhancing mobility, inspiring innovation, and fostering talent; explain how?

These changes are in line with promoting safety and enhancing mobility by preventing the misuse of high-strength fasteners on structural connections.

What financial impact does the change have; project costs, pay item structure, or consultant fees?

No financial impacts.

What impact does the change have on production or construction schedules?

No impacts to production or construction schedules.

How does this change improve efficiency or quality?

This change improves quality by preventing the misuse of high-strength fasteners on structural connections.

Which FDOT offices does the change impact?

Structures Design Office, Office of Construction

What is the impact to districts with this change?

No impacts to the districts.

Does the change shift risk and to who?

This change does not shift risk.

Provide summary and resolution of any outstanding comments from the districts or industry.

Comments and Responses are available on the Track the Status of Revisions hyperlink located on the Specifications landing page: https://www.fdot.gov/programmanagement/Specs.shtm

What is the communication plan?

Through the established specification revision process (e.g., Internal and Industry Review)

What is the schedule for implementation?

The Standard Specifications eBook and Workbook are effective July 1st every year.

STRUCTURAL STEEL AND MISCELLANEOUS METALS
(REV 5-2-25)

SUBARTICLE 460-1.1 is expanded by the following new Subarticle:

~~**Main or p**~~**460-1.1.1 P**~~**rimary (main) load-carrying members or component:**~~ This designation refers, but is not limited, to the following~~:~~:

~~1~~ Longitudinal ~~or transverse~~ rolled beams ~~or~~and ~~fabricated~~built-up girders (I or box, curved or straight)

~~2~~. Transverse floor beams

~~3.~~ All truss members not designated as cross frames

~~3. Cross frames, diaphragms and connection plates of horizontally curved beams or girders~~

~~4~~. Rib members of steel arches

~~5.~~ ~~5. Bracing members subjected to and specifically designed for traffic live load and/or other loads~~

~~6. Cross frames or diaphragms at pier and abutment supports of tub or box girders (trapezoidal members) and their connection plates~~

~~7~~5.~~.~~ Attachments and components of the above such as splice and~~,~~ cover~~, cross frame and diaphragm connection and gusset~~ plates~~, but not transverse and bearing stiffeners (unless acting as a cross frame or diaphragm)~~

~~8~~6. Cables, moment release pins and links, and hangers

~~9~~7. All steel substructure members except those designated as secondary in the Contract Documents

~~10~~8. Overhead cantilevers, trusses, spans and gantries

~~11~~9. Forgings and castings to be used in bridge machinery ~~Other members as may be identified in the Contract Documents~~

~~12~~10. Other members as identified in the Contract Documents. ~~Forgings and castings to be used in bridge machinery~~

SUBARTICLE 460-1.1 is expanded by the following new Subarticle:

~~**460-1.1.2 Miscellaneous components:**~~ This designation refers to, but is not limited to, the following:

~~1~~. Steel modular joints

~~2~~. Load plates

~~3~~. Bearings

~~4~~. Laminated bearing pads

~~5~~. Aluminum J-arms

~~6~~. Roadway Gratings, inlets, and frames

~~7~~. Steel and aluminum railing

SUBARTICLE 460-1.2 is deleted.

~~**460-1.2 Fabrication Categories:** As a prerequisite for being on the Department's Production Facility Listing, fabricators must currently be accredited in accordance with one of the programs in Table 460-1, by fabrication category/categories of the products that they are producing.~~

~~Fabricators are required to submit their proposed fabrication Quality Control (QC) Plan for review by the Department.~~

~~Table 460-1 Fabrication Categories~~	
~~Structure Type~~	~~Accepted Accreditation Program~~
~~Simple Steel Bridge: Pedestrian bridge (prefabricated steel truss pedestrian bridges meeting the Category 1 conditions of FDOT Design Manual 266.4), bridge grid decking~~	~~AISC Simple Bridge~~
~~Steel Bridge: Vehicular bridge, Pedestrian bridge (all others)~~	~~AISC Advanced Bridge Fracture Critical Endorsement~~
~~Structural Highway Metal Components, Group I: bridge machinery, bridge bearings, modular joints, load plates, laminated bearing pads, cantilever, truss/span, monotube, gantry, mast arms, steel light poles, aluminum light poles, aluminum j-arms, drainage (welded gratings, frames, inlets)~~	~~AISC Components Manufacturer or AWS Welding Fabricator~~
~~Structural Highway Metal Components, Group II: bridge forgings, bridge castings, steel railing, aluminum railing, castings (manhole, grating, inlet, frame), guardrail, coated steel fence, elastomeric bearing pads, stay-in-place forms~~	~~ISO 9001~~
~~Notes: An AISC fracture critical (FC) endorsement is required for all FC work. Other accreditations programs may be submitted to the FDOT State Materials Office for review and consideration in addition to the programs listed in the table above.~~	

ARTICLE 460-2 is deleted and the following substituted:

460-2 Materials.

Provide the materials specified in the Contract Documents in accordance with Sections 6, 105, ASTM A6, and AASHTO/AWS D1.5, Bridge Welding Code. Fabricate all unpainted steel elements using steels with weathering characteristics as defined in ASTM A709 for grades with a "W" suffix.

Structural components designated as ~~"fracture critical"~~ a Nonredundant Steel Tension Member (NSTM) shall conform to the provisions of the AASHTO/AWS D1.5, Bridge Welding Code, Clause 12~~-~~ AASHTO/AWS Fracture ~~Critical~~ Control Plan (FCP) for Non-~~R~~redundant Members, in addition to the requirements of the Contract Documents.

Meet the additional following requirements:

Steel and Miscellaneous Metal Items .....Section 962

Material Testing and Certifications .....Section 962
Galvanizing .....Section 962
Structural Coatings.....Section 560
Structural Coating Materials .....Section 975

SUBARTICLE 460-4.2.1 is deleted and the following substituted:

460-4.2.1 General: All materials arriving at the shop shall be properly identified in accordance with the requirements of ASTM A6. Document all ~~main load-carrying~~primary member material, high-strength fastener assemblies, and weld materials incorporated into the work through the entire fabrication process. Document this material traceability in a report type format that correlates heat numbers to their respective locations in the completed members. Submit diagrams and sketches as requested by the Engineer for clarity.

At the fabrication facility, maintain the records of the material testing and certification processes and component/part identification as part of the fabricator's permanent project records for a period of not less than two years as measured from the last shipment of materials from the fabricator's facility. Submit all project-related records to the Engineer.

Mark the weight on members weighing more than three tons, in a visible location.

SUBARTICLE 460-4.2.2 is deleted and the following substituted:

460-4.2.2 Match Marking of Members and Assemblies: Match mark all connecting members or parts that have been reamed or drilled while assembled. The fabricator shall submit a diagram showing all marks and clearly indicate the location of all the marks on the shop drawings.

Use painted marks, attached metal tags, other durable methods which do not degrade the finish of the piece, including plasma etching or low-stress type steel die stamps to identify and match mark pieces. If steel die stamps are used, they must be blunt nosed or interrupted dot dies, manufactured to produce impressions that are rounded at the bottom of the impression. Re-mark coated type markings as necessary to maintain continuity in traceability. Plasma etching using robotic equipment may be used to mark the surface of a steel plate when done at 10 amps and at 150 inches per minute. Plasma etching outside of these parameters requires Engineer approval.

Mark splice plates and girders so that upon erection, the mark on the splice plate is located opposite a matching mark on the girder. Place the mark on web splice plates, midway down the long side of the plate, on either the right or left side, to correspond with the girder to which the splice plate will be temporarily attached for shipping to the erection site. Make a matching stamp on the girder web opposite the mark on the splice plate.

Place the mark on top or bottom flange splice plates, on the right or left end of the plate, corresponding to the girder to which the plate will be attached for shipment to the erection site. Place a corresponding mark on the girder flange opposite the mark in the splice plate.

As an alternate location for tub girder bottom flange splice plates, place the mark midway down the long side of the plate, on either the right or left side, to correspond

with the girder to which the splice plate will be temporarily attached for shipping to the erection site. Make a matching mark on the girder flange opposite the mark on the splice plate.

Mark girders and beams on the left end, according to the orientation shown in the shop drawings, near the top flange. Mark diaphragms in the middle upper portion of the web. Mark cross-frames in the middle of the top or bottom horizontal member.

When heat numbers and other identification marking are applied by die stamping to ~~fracture critical members~~NSTMs, low stress dies shall be used.

Low-stress die stamp markings applied to ~~fracture critical members~~NSTMs shall be placed in locations or zones shown or described in the approved shop drawings. Low-stress or compression areas are preferred.

Ensure that during fabrication, the heat number is maintained on each primary ~~load-carrying component~~member by paint until the component is permanently joined into a piece marked member or assembly.

SUBARTICLE 460-4.3.1 is deleted and the following substituted:

460-4.3.1 Cutting, Shearing and Machining: Cutting (including burning and sawing), shearing, and machining shall be accomplished in accordance with the AASHTO/AWS 1.5, Bridge Welding Code and the following requirements:

Plane, mill, grind or thermally cut the sheared edges of ~~main load-carrying~~ primary member plate components greater than 5/8 inch thick to a depth of 1/4 inch.

Cut and fabricate steel plates so that the primary direction of rolling is parallel to the direction of the member or component main stress. For flanges and webs, the direction of rolling is parallel to the flanges unless noted otherwise in the Contract Documents. Web splice plates may be rolled parallel to their length.

SUBARTICLE 460-4.3.2.1 is deleted and the following substituted:

460-4.3.2.1 Cold Bending: ~~Fracture critical and non fracture critical p~~Plates and bars shall be cold bent, unless otherwise permitted according to the provisions of Section 460-4.3.2.2.

The minimum bend radii measured to the concave face of the plate, shall be taken as 5.0(t) for all grades and thicknesses of steel conforming to structural steel for bridges, AASHTO M 270M/M 270 (ASTM A709/A709M), where ‘t’ is the thickness of the plate in inches. For cross-frame or diaphragm connection plates up to 0.75 inches, the minimum bending radii may be taken as 1.5(t). For all other grades of steel the minimum bend radii recommendations from the plate fabricator shall be followed, but the radii shall not be less than the minimums specified herein.

Wherever possible, bend lines shall be oriented perpendicular to the direction of final rolling of the plate. If the bend lines are parallel to the direction of final rolling, the minimum bend radii shall be increased to 7.5(t).

SUBARTICLE 460-4.3.2.2 is deleted and the following substituted:

460-4.3.2.2 Hot Bending: ~~Fracture critical and non fracture critical p~~Plates and bars may be ~~bent~~ hot bent subject to the approval of the Engineer. Heat-shrink methods as described in 460-4.3.4 are also permitted. If hot bending is to be employed, the heating and bending procedure shall be submitted for review and approval by the Engineer. The plates and bars shall be bent hot at a temperature above the blue brittle temperature of steel (700° F), not to exceed the temperature limits in Table 460-1~~2~~. The minimum radii of the hot bend must satisfy the requirements of 460-4.3.2.1.

SUBARTICLE 460-4.3.4.2.1 is deleted and the following substituted:

460-4.3.4.2.1 Maximum Temperatures: The maximum allowable temperature to which the material can be heated is given in Table 460-1~~2~~, Maximum Temperature Limits for Heat Applications.

Table 460-1~~2~~
Maximum Temperature Limits for Heat Applications

ASTM A709 Grade	Maximum Temperature, °F
36, 50, 50S, 50W & HPS 50W	1,200
HPS 70W & HPS 100W	1,100

SUBARTICLE 460-4.3.4.2.3 is deleted and the following substituted:

460-4.3.4.2.3 Allowable Preload Stresses: Preload compressive stresses will be permitted up to 0.5 times the minimum specified yield strength (Fy) of the material. This stress limit is applicable to all steels covered by this specification as listed in Table 460-~~2~~1. If jacks are used, energize and lock off prior to the application of heat.

SUBARTICLE 460-4.3.4.5.1 is deleted and the following substituted:

460-4.3.4.5.1 General: Procedures for cambering of built-up plate girders shall be submitted as a part of the Producer Quality Control (QC) Plan. In the procedures, address any proposed preloading and heat application and control. Minor heat adjustments in camber at the finishing stage of the girder do not require approval if the patterns and temperatures are followed in accordance with the approved procedures.

Do not utilize heat-cambering as the primary source of vertical camber in horizontally curved ~~main load-carrying~~primary members; cut the web plate to the required position. Only use heat-cambering on horizontally curved ~~main~~primary members to adjust cut cambering with the approval of the Engineer.

460-4.3.4.8 Contact and Bearing Surfaces: Provide surface finishes of bearings, base plates, and other contact surfaces in accordance with the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I, given in Table 460-23, ANSI Surface Roughness Requirements.

Table 460-23 ANSI Surface Roughness Requirements	
Steel slabs	ANSI 2000 micro-inch
Heavy plates in contact with shoes to be welded	ANSI 1000 micro-inch
Milled ends to compression members, milled or ground ends of stiffeners or rockers	ANSI 500 micro-inch
Bridge rollers and rockers	ANSI 250 micro-inch
Sliding bearings	ANSI 125 micro-inch
Pins and pin holes	ANSI 125 micro-inch

SUBARTICLE 460-4.3.5.1 is deleted and the following substituted:

460-4.3.5.1 General: Unless shown otherwise in the Contract Documents, the bolt hole geometry is ~~to be as~~ shown in Table 460-34, Bolt Hole Geometry.

Table 460-34 Bolt Hole Geometry				
Bolt Diameter (d), inch	Standard (Diameter, inch)	Oversize (Diameter, inch)	Short-Slotted (Width, inch by Length, inch)	Long-Slotted (Width, inch by Length, inch)
1/2	9/16	5/8	9/16 x 11/16	9/16 x 1 1/4
5/8	11/16	13/16	11/16 x 7/8	11/16 x 1 9/16
3/4	13/16	15/16	13/16 x 1	13/16 x 1 7/8
7/8	15/16	1 1/16	15/16 x 1 1/8	15/16 x 2 3/16
1	1 1/8~~16~~	1 1/4	1 1/8~~16~~ x 1 5/16	1 1/8~~16~~ x 2 1/2
> 1 1/8	d + 1/8~~16~~	D + 5/16	(d + 1/8~~16~~) x (d + 3/8)	(d + 1/8~~16~~) x (2.5 x d)
Note: Except as shown elsewhere in the Contract Documents, bolt holes in the connections of primary members are to be standard size.				

SUBARTICLE 460-4.3.5.2 is deleted and thee following substituted:

460-4.3.5.2 Holes, Tolerances and Quality: Make bolt (and anchor rod) holes using any method suitable to the Fabricator and as specified below; except ~~for high strength fasteners in main or~~ holes in primary ~~load-carrying~~ members ~~which~~ are not to be punched full size. Bolt holes in primary members~~, but~~ may be thermally cut in accordance with 460-4.3.5.4 and ground smooth with the approval of the Engineer.

The misalignment of holes in a bolt group relative to the same holes in the component or components it is joined to in a connection, shall not exceed 1/32 inch for 85% of the bolt holes in that group. Bolt holes are to be normal to the work and have no tears, cracks, fins, dirt, loose rust, burrs or other anomalies, and the surface is to be flat within a slope of 1/20. Bolt holes are to be round within plus or minus 1/32 inch and within plus or minus 1/32 inch of the specified size. For subsize holes, a pin 1/8 inch smaller than the subsize holes must be able to pass through all assembled plies in at least 75% of the locations prior to reaming. Holes inclined more than 3 degrees to a surface in any direction must have a hardened beveled washer provided at that face. Unless specified elsewhere in the Contract Documents, it is not required to coat the inside of the bolt holes.

SUBARTICLE 460-4.3.5.5 is deleted and the following substituted:

460-4.3.5.5 Punching: Material forming parts of a member composed of five thicknesses or less of metal may be punched full-size. When more than five thicknesses of material are joined, material shall be subdrilled or subpunched and then reamed full-size, or drilled full-size while in assembly. Subpunched or subdrilled holes, when required, must be at least 3/16 inches smaller than the finished hole size.

Holes in secondary members such as cross frames, lateral bracing components, and the corresponding holes in connection plates between girders and cross frames or lateral components may be punched full size. ~~Holes in longitudinal main load-carrying members, transverse floorbeams, and any components designated as fracture critical (FCMs) shall not be punched full-size.~~

SUBARTICLE 460-4.3.5.6 is deleted and the following substituted:

460-4.3.5.6 Edge Distance: Provide minimum as-fabricated distance from the center of a bolt hole to an edge as given in Table 460-4~~5~~, Edge Distances, unless otherwise shown in the Contract Documents.

Table 460-4~~5~~ ~~Edge Distances~~		
Fastener Size, Inch	~~Sheared Edge, Inch~~	~~Rolled Edges of Plates or Shapes or Gas Cut~~ Edge~~s~~ Distances, Inch
1/2		3/4
5/8	~~1-1/8~~	7/8
3/4	~~1-1/4~~	1
7/8	~~1-1/2~~	1-1/8
1	~~1-3/4~~	1-1/4
1 1/8		1-1/2

SUBARTICLE 460-4.4.2.5 is deleted and the following substituted:

460-4.4.2.5 Horizontally Curved ~~Beams and~~ or Skewed Steel Girders: Account for torsion induced deflections for horizontally curved ~~beams and~~or skewed steel girders. ~~Unless otherwise defined in the Contract Documents, a horizontally curved beam or girder is a longitudinal or transverse bridge component with a radius less than 10,000 feet anywhere along its continuous length.~~

SUBARTICLE 460-4.5.1.4 is deleted and the following substituted:

460-4.5.1.4 Computer-Numerically-Controlled (CNC) Drilling Associated with Progressive Girder, Truss or Chord Assembly: If the Fabricator chooses to drill the holes in all plies of all connections of the continuous ~~main~~primary girder or beam line, truss, arch rib, bent, tower face or rigid frame and any intersecting (transverse) members utilizing computer-controlled-numerical drilling procedures, piece-wise assembly of the entire continuous girder or beam line, truss, arch rib, bent, tower face or rigid frame is not required if the following requirements are met:

Prior to transporting to the site, perform a check fit of the first three spans, panels, field sections, segments or longitudinal chords; or entire first bent, tower face or rigid frame of the structure to ensure the accuracy of the CNC procedures and equipment.

As selected by and at the discretion of the Engineer and prior to transporting to the site, perform another check fit of a different assembly of three spans, panels, field sections, segments or longitudinal chords; or another entire bent, tower face or rigid frame of the structure to ensure that the accuracy of the CNC procedures and equipment is maintained. If either of the above fails to meet the Contract requirements, assemble the entire girder or beam line, truss, arch rib, bent, tower face or rigid frame as originally prescribed in 460-4.5.1.1 or 460-4.5.1.2 as prescribed elsewhere in the Contract Documents. Account for transverse members indicated elsewhere in the Contract Documents to be included in the shop assembly as in 460-4.5.1.1.

SUBARTICLE 460-5.1 is deleted and the following substituted:

460-5.1 General: Use ASTM F3125 Grade A325 (Grade A325) for ~~H~~high strength bolts. ~~are described as follows:~~

~~1. ASTM F3125 Grade A325 or as Grade A325.~~

~~2. ASTM F3125 Grade A490 or as Grade A490~~

Use bolts as follows:

1. Use galvanized Grade A325 Type 1 bolts in all field installed bolted structural steel connections for painted steel.

2. Use either plain~~black~~ or galvanized Grade A325 Type 1 bolts in all shop installed bolted structural steel connections that will be shop painted.

3. Use plain~~black~~ Grade A325 Type 3 bolts in all bolted structural steel connections for weathering steel that is to remain unpainted.

4. Use the bolts as specified for connected assemblies or parts that are designated as miscellaneous components where the fastener type is specified elsewhere in the Contract Documents.

Tighten Grade A325 bolts in accordance with the procedures specified below for turn-of-nut or direct-tension-indicator (DTI) tightening.

Lubricate and maintain consistency in lubrication of fastener assembly during Rotational Capacity (RC) testing and installation. Assemblies that exhibit a loss of lubrication, as determined by the Engineer, may be re-lubricated and retested prior to installation.

~~Use Grade A490 bolts only with the approval of the Engineer. Submit procedures in accordance with ASTM F3125 Grade A490 for the handling, lubrication, installation, tightening and testing of such bolts. Do not install Grade A490 bolts without prior approval of the procedures by the Engineer.~~

When the Engineer approves ASTM A307 bolts for use in miscellaneous components, tighten them such that the plies of the joint are in firm contact. Use three to five impacts of an impact wrench or the full effort of a person using an ordinary spud wrench to obtain a snug connection.

Fasten aluminum, other materials or assemblies of dissimilar materials in accordance with the Contract Documents.

Install ordinary rough or machine bolts and nuts in accordance with the Contract Documents.

SUBARTICLE 460-5.2.1 is deleted and the following substituted:

460-5.2.1 Rotational Capacity (RC) Tests: At the location of and prior to installation of permanent high-strength fasteners in ~~main or~~ primary ~~load-carrying~~ member connections, perform RC tests in accordance with FM 5-581 (for long bolts) or FM 5-582 (for short bolts) to ensure that the fasteners are capable of developing the specified strength and that the fasteners are properly lubricated. As a minimum, test two assemblies per LOT designation. The bolt, nut and washer shall come from the same LOT and be packed in the same container (or group of containers assigned the same LOT), except in special cases where nuts and washers have only one production LOT number for each size.

Short bolts may also be tested using FM 5-583 with DTIs calibrated with long bolts installed in a Tension Measuring Device.

Washers are required for RC tests even though they may not be required for jobsite installation. Where washers are not required for jobsite installation, LOT identification is not required. The washer coating shall be the same as that for the bolt and nut.

If any of the required tests fails, the entire LOT will be rejected.

SUBARTICLE 460-5.3 is deleted and the following substituted:

460-5.3 Reuse and Retightening: Do not reuse ~~Grade A490 bolts or~~ galvanized Grade A325 bolts. Plain~~Black~~ Grade A325 bolts with free spinning nuts may be reused one time with the Engineer's approval. Previously tightened bolts that may have been loosened by the tightening of adjacent bolts can be further tightened from the original position. Ensure proper lubrication prior to retightening. Discard and replace fractured or damaged bolts.

SUBARTICLE 460-5.4.6 is deleted and the following substituted:

460-5.4.6 Installation of Fastener Assemblies: Unless shown otherwise in the Erection Plan, install the bolts of the connection by progressing systematically from the most rigid part of the connection to the free edges. Install bolts in all holes of the connection and bring them to a "snug tight" condition. Following the sequence indicated in the Erection Plan, further tighten all the bolts in the connection.

For Grade A325 bolts, obtain the required bolt tension as shown in Table 460-56, Minimum Required Fastener Tension in accordance with the turn-of-nut method specified in 460-5.4.8, or when DTIs are used, the DTI tightening method specified in 460-5.4.9.

For connections (such as large ~~main load-carrying~~primary members or truss joints) in which previously tightened high strength bolts become loose and require retightening upon the tensioning of others, install into a minimum of ten percent of the holes fully tensioned bolts prior to final tensioning of the permanent bolts. Distribute these first bolts randomly throughout the connection. If directed by the Engineer, remove the initial bolts and install permanent bolts at each location, otherwise retighten in accordance with 460-5.3.

Table 460-56
Minimum Required Fastener Tension

Bolt Size, inch	Tension Grade A325 bolts, kips
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1-1/8	64
1-1/4	81
1-3/8	97
1-1/2	118

SUBARTICLE 460-5.4.8 is deleted and the following substituted:

460-5.4.8 Turn-of-Nut Tightening: For each work shift, perform tests utilizing a representative sample of five fastener assemblies, from each LOT to be installed that shift. Perform the tests using the tension measuring device, following the same procedure to be used for actual installation of the fastener assemblies, to a snug-tight tension and corresponding torque, which, when the additional turns required in Table 460-67, Nut Rotation from the Snug-Tight Condition are added, will result in at least 1.05 times the minimum required fastener installation tension as shown in Table 460-56. Place a washer under the part turned in the tightening of the bolt. Consider the job inspection snug-tight torque as the average of three test values determined after rejecting the high and low-test values.

For fastener assemblies too short to fit in the tension measuring device, modify the determination of the job inspection snug-tight torque in accordance with FM 5-582.

460-5.4.8.1 Snug-Tight Condition: In the turn-of-nut method, first bring all the fastener assemblies of the connection to a "snug-tight" condition to ensure that all parts of the connection are in firm contact with each other. For the purposes of this specification, "firm contact" shall mean the condition that exists on a faying surface when the plies are solidly seated against each other, but not necessarily in continuous contact. Regard snug-tight as the tightness required to produce the bolt tension, which following the final applied rotation, produces at least 1.05 times the minimum required bolt tension in accordance with Table 460-5~~6~~, Minimum Required Fastener Tension. In the presence of the Engineer, and on a daily basis, determine the job inspection snug-tight torque as specified herein.

460-5.4.8.2 Final Tightening: After verification of the snug-tight condition in accordance with 460-5.4.11 by the Engineer, tighten all fastener assemblies in the joint by applying the applicable amount of nut rotation specified in Table 460-6~~7~~, Nut Rotation from the Snug-Tight Condition. Once snug-tight, bring all fasteners to the required tension within the same work shift.

Table 460-6~~7~~
Nut Rotation from the Snug-Tight Condition

Bolt Length Measured from Underside of Head to End of Bolt	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis and Other Face Sloped Not More than 20:1. Bevel Washer not Used.	Both Faces Sloped Not More than 20:1 from Normal to Bolt Axis. Bevel Washers not Used.
Up to and Including Four (4) Diameters	1/3 turn	1/2 turn	2/3 turn
Over Four (4) Diameters but not Exceeding Eight (8) Diameters	1/2 turn	2/3 turn	5/6 turn
Over Eight (8) Diameters but Not Exceeding Twelve (12) Diameters	2/3 turn	5/6 turn	1 turn

Notes:
1. Nut rotation is relative to the bolt, regardless of the element being turned.
2. Tolerance for bolts installed by 1/2 turn or less is ± 30 degrees. For bolts installed by 2/3 turn or more, the tolerance is ± 45 degrees.
3. Nut rotations given are only applicable to connections in which all material within the grip of the bolt is steel.
4. For bolt lengths exceeding 12 diameters, establish the required rotation by performing actual tests in a suitable tension device simulating the actual conditions. Submit procedures to the Engineer for review.

SUBARTICLE 460-5.4.9.2 is deleted and the following substituted:

460-5.4.9.2 Final Tightening: After verification by the Engineer that the snug-tight condition for all bolts has been met, tighten all fastener assemblies in the joint such that the number of spaces in which the 0.005 inch thickness gauge is refused is equal to or greater than the number shown in Table 460-7~~8~~, DTI Device Tightening Criteria. Once snug-tight, bring all fasteners to the required tension within the same work shift.

Table 460-78 DTI Device Tightening Criteria						
Number of Spaces in DTI	4	5	6	7	8	9
Minimum Spaces in which Gage is Refused	2	3	3	4	4	5

SUBARTICLE 460-5.4.10.1 is deleted and the following substituted:

460-5.4.10.1 General: Provide ASTM F436 hardened steel washers as follows:

~~1. For connections (and all associated testing) using Grade A490 bolts, use a hardened washer under each element.~~

21. For connections using Grade A325 bolts, use hardened washers under the turned element.

32. Use hardened steel washers as part of the Rotational Capacity tests.

43. Where the outer face of the bolted parts has a slope of greater than 20:1 with respect to a plane normal to the bolt axis, use a hardened, beveled washer to compensate for the lack of parallelism.

54. Where Grade A325 bolts are to be installed in an oversized or slotted hole in an outer ply, provide a single washer satisfying ASTM F436, or continuous bar satisfying ASTM A709~~: for Grade A325 bolts, provide~~, with a thickness of at least 5/16 inch.~~; and for Grade A490 bolts, provide a thickness of 3/8 inch.~~ Provide these washers or bars to completely cover the slot after installation. Provide a finish consistent with the bolt specified.

65. In non-Direct-Tension-Indicator (DTI) applications, clip washers on one side to a point not closer than 7/8 of the bolt diameter from the center of the washer, if necessary.

SUBARTICLE 460-5.4.11.1 is deleted and the following substituted:

460-5.4.11.1 Turn-of-Nut Tightening:

1. Once the snug-tight condition is achieved for all of the fastener assemblies of the connection, within 24 hours of snugging the first bolt in the connection and in the presence of the Engineer, verify for a minimum of three (3) bolts [two (2) for two bolt connections] or 10% of the fastener assemblies, that the job inspection snug-tight torque has been attained. These fasteners are to have a snug-tight torque equal to or exceeding that specified in 460-5.4.8. Perform this check using the same torque wrench used in 460-5.4.8. For bolts tested in accordance with FM 5-583 or when multiple torque wrenches are required, provide a calibrated torque wrench or wrenches.

2. If the tested fasteners do not obtain the job inspection snug-tight torque, test all remaining untested fastener assemblies using the torque wrench in the connection in question. Following testing of all assemblies, bring to snug-tight all assemblies and retest as

stated above. Re-snug and retest as necessary using the calibrated torque wrench until the minimum testing stated above is performed favorably.

3. Following confirmation of the snug-tight condition as performed by the Contractor, and in the presence of the Engineer, match mark the fastener assemblies on the end of the bolt thread and on the nut, and then tighten the nut the amount of rotation specified in Table 460-67, Nut Rotation from the Snug-Tight Condition. The Engineer will accept the connection as fully tightened when all of the following conditions are met:

a. the rotation specified in Table 460-67 has been achieved,

b. there are no loose assemblies in the connection,

c. all plies of the connection are in firm contact,

d. there are no indications that excessive stretching or yielding has occurred in the fastener assembly,

e. bolt stick-through is consistent per LOT.

SUBARTICLE 460-6.4.1 is deleted and the following substituted:

460-6.4.1 Highway Sign, Lighting and Traffic Signal Support Structures: For structural steel supports for signs, lighting, and traffic signals, comply with the AWS D1.1 Structural Welding Code as amended by the following.

Unless otherwise shown in the Plans, perform ultrasonic testing (UT) or radiographic testing (RT) on complete joint penetration welds (except for backing bar splices) at the following frequency (use the AWS D1.1 Tubular Connections Class R Criteria for UT and Cyclically Loaded Criteria for RT.

One hundred percent of each joint subject to tension or reversal of stress.

Twenty-five percent of each joint subject to only compression or shear. If discontinuities are found in the joint, the remainder of the joint shall be tested.

Perform Magnetic Particle Testing at the following frequencies:

A minimum of 25% of all fillet or partial penetration groove welds in ~~main~~primary members (Use the AWS D1.1 Tubular Connections Criteria). If discontinuities are found, the remainder of the welds on the members shall be tested.

SUBARTICLE 460-6.4.2 is deleted and the following substituted:

460-6.4.2 Tubular Bridge: Comply with the requirements of the AWS D1.1 Structural Welding Code as amended by the following:

Unless otherwise shown in the Plans, perform ultrasonic testing (UT) or radiographic testing (RT) on complete joint penetration welds at the following frequency (use the AWS D1.1 Tubular Connections Class R Criteria for UT and Cyclically Loaded Criteria for RT).

One hundred percent of each joint subject to tension or reversal of stress.

Twenty-five percent of each joint subject to only compression or shear. If unacceptable discontinuities are found in the joint, the remainder of the joint shall be tested.

Perform Magnetic Particle Testing at the following frequencies:

A minimum of 25% of all fillet or partial penetration groove welds in ~~main~~primary members (Use the AWS D1.1 Tubular Connections Criteria). If unacceptable discontinuities are found, the remainder of the welds on the members shall be tested.

SUBARTICLE 460-6.4.3 is deleted and the following substituted:

460-6.4.3 Overhead Sign Structures and Toll Gantries: Comply with the requirements of the AWS D1.1 Structural Welding Code as amended by the following:

Unless otherwise shown in the Plans, perform 100 percent ultrasonic testing (UT) or radiographic testing (RT) on all complete joint penetration welds.

Prior to galvanizing, perform Magnetic Particle Testing (MT) at the following frequencies:

One hundred percent of all fillet or partial penetration groove welds in the upright columns. A minimum of 25% of all other fillet or partial penetration groove welds in ~~main~~primary members other than upright columns. If unacceptable discontinuities are found, the remainder of the welds on the member shall be tested.

After members are galvanized, perform one hundred percent MT of all fillet welds in the upright columns.

For acceptance, use AWS D1.1 Tubular Connection Criteria for MT, Tubular Connection Class R Criteria for UT, and Cyclically Loaded Criteria for RT.

SUBARTICLE 460-7.1.3 is deleted and the following substituted:

460-7.1.3 Erection Plan: Submit, for the Engineer's review, an Erection Plan locating all primary members, lifting equipment and temporary supports or braces, and bolting pattern tightening procedures not considered routine. Ensure that the plan includes the Specialty Engineer's signature and stamp. Include supporting calculations indicating that the design unit stresses indicated in the Contract Documents have not been exceeded. Submit this plan or plans to the Engineer three weeks before erecting the piece or pieces.

Include the following information in the Erection Plan:

1. A plan of the work area showing all substructure units and foundations; surface roads and railroads; all streams, creeks and rivers; all overhead utilities; and any underground utilities that could possibly impact, or be adversely affected by, erection operations as determined by the Specialty Engineer.
2. The erection sequence for all primary ~~load-carrying~~ members and all primary ~~load-carrying~~ member bracing. Note any and all permanent or temporary support and/or bracing locations, including crane-holding positions.
3. The center of gravity locations, pick weight and delivery orientation for all primary ~~load-carrying~~ members.
4. Identify any bolting requirements not considered routine.
5. Locate all pick crane work points.
6. Identify all temporary works and staging areas such as barges, mats and temporary excavation support.
7. Include capacity charts on the drawings for each crane configuration and boom extension utilized.

8. Details of all temporary bracing, falsework, towers and shoring.
9. Submit any procedures requested by the Engineer and not contained in the Erection Plan.

SUBARTICLE 460-7.3 is deleted and the following substituted:

460-7.3 Coordination with Substructure: Prior to the erection of primary ~~load-carrying~~ members, conduct a survey to document the vertical, longitudinal and transverse position of all substructure units and anchor rod locations. Appropriately account for ambient temperature in the survey.

Should a discrepancy be identified with the Contract Documents, submit the necessary details to the Engineer for resolution.

SUBARTICLE 460-7.7 is deleted and the following substituted:

460-7.7 Bolted Connections: For splice connections of primary members, as well as connections of diaphragms or cross-frames, fill at least 50% of the holes prior to crane release. The 50% may be either erection bolts in a snug tight condition or full size erection pins, but at least half (25% of all holes) shall be bolts, and sufficient pins shall be used near outside corners of splice plates and at member ends near splice plate edges to ensure alignment. Filled holes should be uniformly distributed between the web and flange connections for primary members such that approximately 50% of the web connections are filled and approximately 50% of the flange connections are filled. For diaphragms or cross-frames, the filled holes should be uniformly distributed between all the bolt groups connecting the diaphragm or crossframe to the primary member. The 50% requirement may be waived if a reduced percentage is calculated as sufficient and shown on the approved Erection Plan. Primary member splice connections that are made up on the ground (prior to erection) shall be 100 percent complete prior to any lifting operation. Fully tighten all bolts prior to installation of deck forming for each unit.

SUBARTICLE 460-7.9.1 is deleted and the following is substituted:

460-7.9.1 General: Perform Quality Control inspections of all phases of the work. The inspection frequency and depth shall be sufficient to ensure that all materials and workmanship incorporated into the work meet the requirements of the Contract Documents and that the processes are controlled to ensure that the final finished product(s) conform to the physical characteristics and dimensions required by the Contract Documents. The Quality Control Manager shall be responsible for all inspection operations. An adequate number of Quality Control Inspectors shall be available to ensure review of all materials and fabrication processes are ~~preformed~~performed in accordance with the Producer QC Plan. Weekly meetings shall be held with the Engineer to review inspection findings. The review of this information is to identify any refinements and/or improvements in the process being utilized in the work. The frequency of the meetings may be altered by the Engineer.

SUBARTICLE 460-8.5 is deleted and the following substituted:

460-8.5 High-Strength Fastener Assemblies: The weight of high-strength fastener assemblies (including nuts and washers) installed by the Contractor and accepted by the Engineer will be computed on the basis of an average length in accordance with Table 460-~~9~~8:

Table 460-~~9~~8 Weights of High-Strength Fastener Assemblies					
Diameter of High-Strength Fasteners, inch	3/4 inch	7/8 inch	1 inch	1-1/8 inches	1-1/4 inches
Weight per 100, pounds	52	100	135	182	238