

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH)

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes all Work necessary to design, fabricate, package, ship and deliver tubular steel structures to the Owner as indicated and specified.

1.02 REFERENCES:

- A. Applicable References: Reference versions shall correspond to the specified version of ASCE/SEI 48. For references not included in ASCE/SEI 48, reference version shall correspond to the latest version at time of specification issuance.
1. American Concrete Institute (ACI):
 - a. 318 - Building Code Requirements for Structural Concrete.
 2. American Welding Society (AWS):
 - a. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. D1.1 - Structural Welding Code - Steel.
 3. American Society of Civil Engineers (ASCE) and Structural Engineering Institute (SEI):
 - a. 48- 19 - Design of Steel Transmission Pole Structures.
 4. American Society for Testing and Materials (ASTM):
 - a. A6 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, Sheet Piling.
 - b. A36 - Carbon Structural Steel.
 - c. A90 - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - d. A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - e. A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - f. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - g. A239 - Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles.
 - h. A350 – Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components.
 - i. A354 - Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
 - j. A370 - Mechanical Testing of Steel Products.
 - k. A384 - Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
 - l. A385 - Providing High-Quality Zinc Coating (Hot-Dip).
 - m. A388 – Ultrasonic Examination of Steel Forgings.
 - n. A449 - Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
 - o. A563 - Carbon and Alloy Steel Nuts.
 - p. A572 - High-Strength Low Alloy Columbium-Vanadium Structural Steel.
 - q. A577 - Ultrasonic Angle-Beam Examination of Steel Plates.
 - r. A578 - Straight Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications.
 - s. A595 - Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 - t. A615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

- u. A633 - Normalized High Strength Low-Alloy Structural Steel.
 - v. A673 - Sampling Procedure for Impact Testing of Structural Steel.
 - w. A678 - Quenched and Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates.
 - x. A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - y. A788 – Steel Forgings, General Requirements.
 - z. A1090 - Forged Rings and Hollows for Use as Base Plates in Power Transmission Structures.
 - aa. B6 - Zinc.
 - bb. E165 - Liquid Penetrant Testing for General Industry.
 - cc. E376 - Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods.
 - dd. E709 - Magnetic Particle Testing.
 - ee. F3125 - High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
5. American Society for Nondestructive Testing (ASNT)
- a. Recommended Practice No. SNT-TC-1A, Supplement A through E.
- B. In cases where the above standards are in conflict, unless specifically noted elsewhere in the Contract Documents, the Supplier shall request clarification from the Engineer.

1.03 SUBMITTALS:

- A. Submit as specified in Division 01.
- B. Bid Submittals:
 - 1. Provide calculations, drawings, and data necessary for evaluation of the Supplier bid.
 - a. Fabrication plan, including the number of facilities used for manufacturing and their geographical locations.
 - b. Material plan, including material type, source, and specification to be used for pole, base plates, and arms. Supplier may propose forged rings conforming to ASTM A350 Grade LF6 class 2 as an alternate to a standard base plate design. The proposal shall indicate required information for both options.
 - c. Inspection & Test Plan which covers the details of testing and inspection including applicable weld standards, performance requirements, sampling frequency, and testing method for each component to show compliance with the requirements of these specifications and referenced standards.
 - d. The recommended construction procedures required to prevent arm damage due to wind-induced vibration prior to conductor and/or insulator installation. Failure to submit this data will be construed as Supplier's guarantee that no damage due to wind-induced vibration will occur on free-standing structures without wires and/or insulators installed.
 - e. Assembly, handling, storage, and installation guidelines.
 - f. Structure calculations:
 - (1) The horizontal and vertical deflection as measured from the horizontal and vertical axis, for each specified loading condition at each level of wire attachment and the top of the structure.
 - (2) Complete calculations used in the design of each structure, including stress calculations, w/t ratios, moments of inertia, for all load cases and details for the arm connection to the pole showing the adequacy of the connection used.
 - (3) Base plate design calculations showing adequacy of base plate thickness and anchor bolt arrangement, size, and quantity.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

- g. Loads on Foundations:
 - (1) The simultaneous shear in each direction, simultaneous moment in each direction, and vertical load at each structure's base plate or groundline for each loading condition indicated in the Contract Drawings.
 - (2) For multiple-leg or multiple-column structures, the simultaneous loading at the base of each column or leg for each loading condition indicated in the Contract Drawings.
- C. Action Submittals:
 - 1. Provide detailed drawings and data necessary for the design, assembly, and erection of all structures furnished, including, but not limited to the following:
 - a. Structure Calculations:
 - (1) The horizontal and vertical deflection as measured from the horizontal and vertical axis, for each specified loading condition at each level of wire attachment and the top of the structure.
 - (2) Complete calculations used in the final design of each structure, including stress calculations, w/t ratios, moments of inertia, for all load cases and details for the arm connection to the pole showing the adequacy of the connection used.
 - (3) Base plate design calculations showing adequacy of base plate thickness and anchor bolt arrangement, size, and quantity.
 - b. Loads on Foundations:
 - (1) The simultaneous shear in each direction, simultaneous moment in each direction, and vertical load at each structure's base plate or groundline for each loading condition indicated in the Contract Drawings.
 - (2) For multiple-leg structures, the simultaneous loading at the base of each leg for each loading condition specified and indicated in the Contract Drawings.
 - c. Complete Fabrication and Erection Drawings for each structure with complete dimensions and welding symbols per AWS A2.4. Code markings to correspond with identical markings stamped on the individual fabricated steel members and assemblies (before galvanizing).
 - d. Anchor bolt setting plans, including size, length, and quantity of anchor bolts per structure.
 - 2. All final Calculations and Drawings shall be performed and sealed by a registered Professional Engineer in the jurisdiction that the Project is located.
 - 3. Provide data files in PLS-POLE Version 21.0 format and include a model of each structure type and height for inclusion into the PLS-CADD design model. All PLS-POLE model files shall be submitted electronically in "backup" file format with one set of commonly referenced library files.
 - 4. Updated Fabrication and Inspection & Test plans.
 - a. Supplier shall issue an approved Inspection & Test Plan which covers the details of visual and nondestructive inspection. The plan shall include the number and type of tests and the percentage required. Inspection and Test Plans must be approved prior to the start of fabrication.
 - 5. Supplier Assembly and Installation Guidelines including instructions for bolt tightening. Provide installation torque values or turn-of-nut guidance for all bolts/nuts including, but not limited to, anchor bolts, flange connections, and arm connections.
 - 6. Test Reports: Submit as specified in Division 01 for all material supplied.
 - a. Mill test and material test reports.
 - b. Charpy "V" notch impact tests, as specified.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

7. Weld procedures and inspection reports documenting the inspection activity during fabrication.
 - a. Reports showing compliance with the requirements of these specifications.
 8. Weld maps showing where each weld procedure is to be used.
 9. All non-destructive evaluations (NDE) procedures.
 10. Galvanizing Procedures and Galvanizing system control procedures.
 11. Post-Galvanizing toe crack inspection – UT / MT.
- D. Information Submittals

1.04 QUALITY ASSURANCE:

- A. The following minimum qualifications are required of the Supplier:
1. Be regularly engaged in the fabrication of tubular steel transmission poles.
 2. Have a staff regularly engaged in the design and detailing of tubular steel poles.
 3. Have previously designed and fabricated tubular steel transmission poles of the general type, strength, and size indicated and specified.
 4. Have a published Quality Manual detailing the activities from raw material purchase to final inspection and coating to shipping.
 5. Employ AWS certified welding inspectors. These certified inspectors shall be used on this project.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL:

- A. Provide new materials, of domestic origin, free from defects and suitable for their application and the mechanical stresses to which they will be subjected shall be used.
- B. Provide structures complete with the following and as required per the Contract Drawings:
1. Fastening hardware.
 2. Brackets and grounding attachments.
 3. Anchor bolt assemblies and templates.
 4. Coatings for field repair of damaged galvanized or ground line coated surfaces.
- C. Spare Materials: Provide 5% more fastening hardware than required to assemble and erect the structures.
- D. All steel plate and coil materials used in the shafts, base plates and miscellaneous hardware shall be made by the open hearth, basic oxygen or electric arc furnace process and conform to ASTM A6. Decoiled and flattened plates shall be tested and recertified per ASTM A6.
- E. Energy-Impact Properties in the longitudinal direction of all structural plate or coil materials shall be determined in accordance with the Charpy V-notch test described in ASTM A370 and, at a minimum, shall meet the requirements of 15 ft-lb (20 J) absorbed energy at a temperature of –20 °F (–29 °C). Absorbed energy requirements for subsize test specimens shall be in accordance with ASTM A370 and A673.
- F. For all plate and coil material of any thickness, heat-lot testing shall be used unless specified otherwise by the Engineer.
- G. Provide materials for shafts, arms, arm brackets, flanges and base plates up to 1-1/4 inch thickness conforming to ASTM A36 or A572. Base plates greater than 1-1/4 inch and up to 4 inches in thickness shall conform to A572 or A633.
- H. Maximum silicon content for A572 steel plate and angles up to 1-1/4 inch thickness shall be 0.06%.
- I. Provide anchor bolts conforming to ASTM A615 or F1554 with ASTM A563 nuts.
- J. Provide bolts conforming to ASTM F3125 Grade A325, Type 1 or A354 Grade BC.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

- K. Nuts shall conform to ASTM A563.
- L. Provide zinc for hot-dipped galvanized coating conforming to ASTM B6.
- M. Any thread protectors used on the structures shall have tabs and be easily removable with the use of pliers.

2.02 GENERAL STRUCTURES DESIGN:

- A. Structure analysis and design shall conform to ASCE/SEI 48 - Design of Steel Transmission Pole Structures.
- B. Description:
 - 1. Structures shall be designed per this specification and the Contract Drawings.
 - 2. Structures shall be able to withstand the loads indicated on the Contract Drawings. The indicated loads include all overload capacity factors, therefore, the allowable material stress shall equal the yield stress modified using the methods included in the ASCE/SEI 48 - Design of Steel Transmission Pole Structures, Chapter 5.2.
 - 3. Pole Shape: Provide 12-sided pole sections.
 - 4. Arm Shape: Provide 8-sided, 6-sided, or 4-sided arm sections.
 - 5. Section Joints: Provide slip joint connections unless otherwise indicated on the Contract Drawings. The Supplier shall determine if the connection type is suitable to withstand the applied loading and shall notify the Engineer if changes to the specified connection type are required.
 - 6. Bearing plates: The bearing plate at the bottom of galvanized direct-embedded type structures shall be open.

2.03 STRUCTURAL DESIGN AND DETAILING:

- A. Anchor Bolts:
 - 1. Design for anchor bolt embedment in drilled shaft and concrete foundations having a minimum compressive strength of 3,000 psi and conforming to ACI 318-83.. The connection of the bolts through the base plate to the foundation shall be designed using the ultimate strength method included in ACI 318-83. The anchor bolt and bond stress shall be per ASCE/SEI 48.
 - 2. Provide a total of three nuts per anchor bolt. One nut is intended to serve as a leveling nut, with the other two nuts serving as the connector between the anchor bolt and base plate.
 - 3. Design to support the structures with leveling nuts on the anchor bolts. The dimension from top of foundation to bottom of base plate shall be a minimum of 1.5 times the bolt diameter and a maximum of 2.0 times the bolt diameter. If the dimension from top of foundation to bottom of base plate exceeds 2.0 times the bolt diameter, bending in the bolt should be considered as discussed in ASCE 48.
 - 4. Provide assemblies with a clear distance of not less than 3” between adjacent bolts.
 - 5. Provide V-notches or equivalent indicator on top anchor bolt template on the structure’s transverse axis. The anchor bolt pattern shall be symmetrical about transverse axis.
 - 6. Templates shall each be a single or welded piece. Templates shall structurally maintain the shape of the assembly regardless of handling and storage orientation. Top template bolt holes shall not be more than 1/8” greater than nominal bolt diameter and shall allow for ease of removal of top template in construction.
 - 7. Anchor bolt holes in base plate shall be 5/16” larger than the nominal diameter of the bolt.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

- B. Foundation Rotation: Structures shall be able to withstand all design loads while subjected to a rotation of 1.5 degrees measured from the vertical axis of the shaft rotated at the indicated ground line or the bottom of the base plate.
- C. The Supplier shall design the poles and arms per the pole and arm deflection limits as indicated on the Contract Drawings.
- D. Precamber: Precambering of structures is not allowed.
- E. Distortion and Warp: Provide members and assemblies conforming to ASTM A384.
- F. Vent and Drain Holes: Provide all fabricated assemblies with vent and drain holes to conform to ASTM A385.
- G. Flange Joints:
 - 1. Shims shall not be allowed.
 - 2. Joint sections shall be match marked.
- H. Slip Joints:
 - 1. The overlap length shall be in accordance with ASCE/SEI 48.
- I. Bolts and Bolt Holes:
 - 1. Member Connections: Fastener sizes and strengths shall be uniform for each structure type.
 - 2. Palnuts shall not be used.
 - 3. Punched Holes: Holes may be punched in steel plate of 3/4 inch thickness or less. Plate material greater than 3/4 inch shall be drilled or subpunched and reamed or cut with a machine guided oxygen torch.
 - 4. All holes shall be perpendicular to the member and be cylindrical, sharp and clean cut without excessive tear-outs or depressions due to punching.
 - 5. Holes adjacent to the gauge line of bends shall be made after bending to avoid distortion.
- J. Provide all necessary hardware and brackets required for complete erection of the structures including jacking lugs and lifting plates.
- K. Corrosion Collar: Provide a 3/16-inch corrosion collar at the ground line as indicated on the Contract Drawings. The structural design shall not include consideration of the collar.
- L. Water Pockets: Design components to allow for proper drainage.
- M. Grounding Attachments: Provide as indicated on the Contract Drawings.
- N. Member Identification: Mark with punched or bead welded identifying numbers a minimum of 1 inch high. Identifying marks shall be legible after galvanizing.
- O. Structures shall be designed so that no field welding will be required.

2.04 TEST OF MATERIALS

- A. All materials for base plates, shafts, crossarms, arms, and major attachments shall be tested for notch toughness on a heat lot basis. Impact energy absorbed shall meet or exceed the values noted in this specification.
- B. Each individual base plate shall be tested in accordance with ASTM A578, level B.
- C. Certified test reports, including complete test results for all structures shall be provided to the Owner per the requirements of this specification.

2.05 FABRICATION

- A. Fabrication drawings shall include welding symbols for each weld joint per AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- B. Weld joints shall be full penetration unless otherwise specified by weld symbols.
- C. Welding procedures shall be qualified per AWS D1.1, latest version. All welding procedures shall be approved prior to the start of fabrication.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

1. When specified in the contract documents, Welding Procedures shall be qualified to meet Charpy V-notch requirements per AWS D1.1. to provide a minimum notch toughness of 15 ft-lbs absorbed energy at -20° F as measured by the Charpy "V" notch test.
 2. Requirements for Charpy V-notch Toughness Testing shall comply with Part D of AWS D1.1.
 3. Charpy V-notch supplementary essential variables shall be addressed and shall be listed on the Procedure Qualification Record & Welding Procedure Specification.
 4. Heat Input shall be specified on the Welding Procedure Specification & Procedure Qualification Record. Heat input shall be controlled and monitored during all welding fabrication.
 5. Prequalified Welding Procedures are allowed when Charpy V-notches are not required. These Welding Procedure Specifications must meet the requirements of AWS D1.1.
 6. All welding materials shall meet the same Charpy V-notch toughness requirements with a minimum of 15 ft-lbs absorbed energy at -20° F as measured by the Charpy V- notch test.
- D. All welding materials shall conform to the latest revision of the "Electrode and Flux Specifications" set forth in AWS D1.1.
- E. Unless otherwise specified in the welding procedure specification, all preheating shall meet the requirements of AWS D1.1.
- F. All welds shall be free from overlaps and cracks.
- G. Longitudinal welds in female slip joint areas and for a minimum of six (6) inches on either side of circumferential seam intersections or attachments intersections shall be 100% penetration.
- H. Longitudinal welds in other areas (e.g., pole shaft and arms) shall be 60% minimum penetration.
- I. All circumferential welds (base and flange plate-to-pole shaft and arm base-to-arm) shall be 100% penetration for the entire length of the welds.
- J. Vang-to-shaft welds, arm box joint welds, and all welds in major load carrying "tee" joints shall be 100% penetration.
- K. Weld quality and weld profiles shall meet the requirements of AWS D1.1.
- L. All undercutting shall meet the requirements of AWS D1.1.
- M. Porosity, fusion and inclusion type defects shall not exceed limits stated in AWS D1.1.
- N. Welding slag shall be removed from all completed welds.
- O. Tightly adhering spatter remaining after cleaning is acceptable unless its removal is required for the purpose of NDT.
- P. Weld joints shall not be painted or galvanized until the weld is accepted by the acting welding inspector. The welding inspector shall meet the qualification requirements of AWS D1.1, section 8.1.4.2.
- Q. All weld repairs shall be in accordance with AWS D1.1 and repaired welds shall be inspected by the same methods and procedures specified for the original welds.
- R. Welding Procedure Specifications for weld repairs shall meet the same requirements as the original Welding Procedure Specifications.
- S. Mechanically remove all welding flux, slag and burrs prior to galvanizing.
- T. Interchangeable Sections: Sections for each structure shall fit and be interchangeable with all other structures of the same height and type.
- U. Stiffeners: If stiffeners are used on flanges or baseplates, they shall be located such that they do not interfere with turning of bolts or nuts using standard tooling. Wrenches and sockets shall be able to rotate a minimum of 60 degrees about the bolt without contacting the stiffeners.
- V. Tolerances: Variations from design dimensions shall not exceed the following:

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

1. Anchor Bolt Cages: The maximum displacement of all bolts in the assembly from the centerline of the bolt holes shall not exceed half the distance between the edge of the bolts and the edge surface of the holes.
2. Arms:
 - a. Length: ± 1 inch in 10 ft of arm length
 - b. Rise: ± 1 inch in 10 ft of arm length.
3. Base Plate:
 - a. Eccentricity relative to center of shaft: $\pm 1/8$ inch.
 - b. Length and width: $+1$ inch or $-1/4$ inch.
4. Flange Connections:
 - a. Eccentricity relative to center of shaft: $\pm 1/8$ inch.
 - b. Face surfaces shall be flat within $1/16$ inch. Surface may be concave but not convex within this tolerance.
5. Holes:
 - a. Displacement: Half the distance between the edge surface of the hole and the edge of the bolt.
 - b. Eccentricity: $\pm 1/16$ inch.
 - c. Size and shape after galvanizing:
 - (1) Joints:
 - (a) Punched holes: $+1/16$ inch larger than the design diameter.
 - (b) Drilled, reamed and subpunched holes: $+1/8$ inch larger than the design diameter.
6. Shafts:
 - a. Diameter: $+1/4$ inch and -0 inch in 12 inches.
 - b. Length (single pole): -0.25% of the total design length.
 - c. Length (multipole): -0.25% of the total design length for each shaft and $+2$ inches variation between shafts.
7. Slip joint overlap: Fabrication drawings shall provide minimum and maximum overlap lengths per the design. If any structures experience overlaps outside the provided range under the specified jacking force, the supplier shall provide a site representative at the request of the Owner at no cost to the Owner.
8. Tolerances are independent. No individual tolerance can be met through combination of multiple specified, referenced, or implied tolerances.

2.06 SURFACE COATING:

A. Hot-Dip Galvanizing:

1. Surface Preparation: Pre-clean utilizing a caustic bath, acid pickle and flux or mechanical method to remove mill scale, rust, grease or other deleterious substances. Protect against embrittlement using the method specified in ASTM A143.
2. Members and Assemblies: Galvanize conforming to ASTM A123 after all bending, cutting, hole drilling, punching, welding and other fabricating operations are complete.
3. Fasteners: Galvanize to conform to ASTM A153.
4. Anchor Bolts: Galvanize the threaded portion of the bolt and 6 inches below the threads to conform to ASTM A153.
5. Finish:
 - a. Provide a galvanized coating that is continuous, adherent and free of uncoated spots, blisters, chemical flux and projections which will interfere with the intended use of the structure and assemblies. Holes shall be clean and free of superfluous spelter.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

- b. Finish shall be generally consistent across the entirety of each section with no obvious ‘striping’.
 - B. Corrosion Resistant Coating:
 - 1. Apply evenly from the top of the corrosion collar to the base of the pole.
 - 2. Surface Preparation: to Manufacturer's recommendations.
 - 3. Thickness: to Manufacturer's recommendations.
- 2.07 INSPECTION:
- A. All welds shall be 100% visually inspected by an AWS Certified Welding Inspector.
 - B. Ultrasonic inspection of all complete penetration welds shall be performed in accordance with AWS D1.1.
 - C. Testing of non-complete penetration welds shall be performed in accordance with AWS D1.1.
 - D. All personnel performing nondestructive testing shall be qualified in accordance with ASNT Recommended Practice No. SNT TC 1A, Supplement A through E and in accordance with AWS D1.1-2020 6.14.6 and 6.35.4.
 - E. When galvanized coating is used, weld tests shall be performed after galvanizing in addition to the testing required to fulfill the requirements of this specification. The frequency of post-galvanization testing shall be proposed by the Supplier based on the types of joints used and the requirements of ASCE/SEI 48. The type of testing and required frequency shall be included in the Inspection & Test Plan.

PART 3 - EXECUTION

- 3.01 DELIVERY, STORAGE AND HANDLING:
- A. Anchor Bolts:
 - 1. Provide preassembled clusters of bolted together anchor bolt cages with top and bottom positioning templates. Templates shall have diameters a maximum of 6 inches larger and smaller than the anchor bolt circle. The top template shall support the assembled cage during lifting and setting operations without detrimental deflection.
 - 2. The need for intermediate templates to provide additional support for the anchor bolt cage shall be determined and indicated on anchor bolt drawings, as necessary, by the Supplier.
 - B. Bundling by Piece:
 - 1. All like pieces for the same structure types shall be bundled and shipped together.
 - 2. Members for two separate structure types shall not be packaged into the same bundles.
 - 3. Small parts, for example, clip angles and U-bolts shall be packed in containers, according to part, size, and structure type. Several individual containers for more than one structure type may be packed into a larger one.
 - 4. Bolts shall be shipped in bulk sorted by diameter and length.
 - 5. Nuts and washers shall be shipped in bulk sorted by diameter.
 - C. Bundling by Structure:
 - 1. As an alternative and in conjunction with bundling by piece, some structures may be bundled by structure.
 - 2. All the pieces necessary to erect one complete structure shall be bundled and shipped together.
 - 3. Members for two separate structures shall not be packaged into the same bundles.

SECTION 33 71 16.23 – TUBULAR STEEL STRUCTURES (FURNISH): continued

4. Small parts, for example, clip angles and U-bolts shall be packed in containers, according to part, size, and structure. Several individual containers for one structure may be packed into a larger one.
5. Bolts shall be shipped in bulk sorted by diameter and length.
6. Nuts and washers shall be shipped in bulk sorted by diameter.
- D. Bolts, nuts and washers shall receive a suitable solvent and be packaged in a sealed container for shipment.
- E. Bundling straps or bands, or their equivalent, and related items as well as containers and crating shall be of sufficient strength to contain and protect the contents under normal export shipping, handling, and storage yard conditions. The banding material shall be galvanized or aluminized steel or other equivalent material which will not rust or otherwise deteriorate during shipping and storage. The containers shall be constructed in a manner which will prevent pilferage of contents from the unopened container.
- F. Vehicles in which steel is shipped or stored shall be clean and free from foreign materials which could in any way injure the steel or the structure coating.
- G. The weight of palletized bundles or containers shall not exceed 8,000 lbs.

3.02 DAMAGED AND MISFABRICATED MEMBERS:

- A. The Supplier shall provide field services of representatives, equipment and material to correct errors, discrepancies or omissions in the structures furnished as required by the Owner
- B. Misfabricated pieces shall be repaired or replaced by the Supplier at no additional cost to the Owner. Costs incurred due to delays or additional labor caused by these misfabricated pieces shall be borne by the Supplier.

END OF SECTION 33 71 16.23