

**Item No. 720S  
Metal for Structures**

**720S.1 Description**

This item shall govern all structural and miscellaneous steel, anchor bolts, and miscellaneous metals used in structures. Reinforcing steel (Item 406S) and other structural materials are not included. This specification is optional and is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

**720S.2 Submittals**

The submittal requirements of this specification item include:

- A. Certification or mill test reports indicating that all materials supplied are in accordance with this specification.
- B. Any material proposed for use and not designated herein, including type and trade name for any material not generically specified by the American Society for Testing and Materials (ASTM). Submittal shall include material specification and technical data as required to show that the proposed material meets the intent of those specified herein.
- C. When SI unit bolts are proposed for use on a project, submit sizing of bolt(s) and the U.S. Customary Unit (USCU) bolt size(s) the SI unit bolt(s) will be substituted for. Note: although this specification includes ASTM standards for both USCU and SI, there is no conversion between these standards; each contains a different set of bolts with different physical size characteristics. When SI unit bolts are used, appropriately sized SI unit nuts and washers shall also be provided.

**720S.3 Structural Steel for Main Members**

Unless otherwise indicated, structural steel for main members shall conform to the longitudinal Charpy V-notch (CVN) requirements in accordance with Table A. Sampling and testing shall be in accordance with ASTM A673 (A673M).

A. Structural Steel

When indicated as Structural Steel, the material shall conform to ASTM A 36 (A36M), with a minimum specified yield strength of 36 ksi (250 MPa).

B. High Strength Structural Steel (HS)

When indicated as Structural Steel-HS, the material shall have a minimum required yield strength of 50 ksi (345 MPa), conforming to one of the following ASTM specifications:

- 1. ASTM A 572 (A572M).
- 2. ASTM A 588 (A588M).

3. ASTM A709 (A709M).
4. ASTM A992 (A992M).

C. Extra High Strength Structural Steel (XHS)

When indicated as Structural Steel-XHS, the material shall have a minimum specified yield strength of 90 ksi (620 MPa), conforming to one of the following ASTM specifications:

1. ASTM A 514 (A514M). Structural shapes and seamless tubing, meeting the requirements of A514 (A514M) will be permitted with a maximum tensile strength of 140 ksi (965 MPa) for structural shapes and 145 ksi (1,000 MPa) for seamless tubing.
2. ASTM A 517 (A517M).

ASTM A514 (A514M) and ASTM A517 (A517M) steels are considered weldable.

TABLE A				
Min. Spec. Yield Strength, F <sub>y</sub> [ksi (MPa)]	Thickness, t [in. (mm)]	Welded	Mech. Fastened	Min. CVN Toughness [ft. lb. @ °F (J @ °C)]
F <sub>y</sub> ≤ 40 (275)	t ≤ 4 (100)	X	X	15 @ 70 (20 @ 21)
40 (275) < F <sub>y</sub> ≤ 65 (450)	t ≤ 2 (50)	X	X	15 @ 70 (20 @ 21)
	2 (50) < t ≤ 4 (100)	X	X	15 @ 70 (20 @ 21)
65 (450) < F <sub>y</sub> ≤ 90 (620) (Refer to note 3 below)	2 (50) < t ≤ 4 (100)	X	X	20 @ 70 (27 @ 21)
	t ≤ 2.5 (65)	X	X	20 @ 50 (27 @ 10)
	2.5 (65) < t ≤ 4 (100)	X	X	20 @ 50 (27 @ 10)
	2.5 (65) < t ≤ 4 (100)	X	X	25 @ 50 (34 @ 10)

Notes for Table A:

1. For F<sub>y</sub> ≤ 50 ksi (345 MPa), use the (H) frequency of testing in accordance with ASTM A673 (A673M).
2. For F<sub>y</sub> > 50 ksi (345 MPa), use the (P) frequency of testing in accordance with ASTM A673 (A673M).
3. If the yield strength of the material exceeds 90 ksi (585 MPa), the testing temperature shall be reduced 15°F (8.3°C) per 10 ksi (69 MPa) increment, or portion thereof.

**720S.4 Miscellaneous Steel**

A. High Strength Bolts

High strength bolts shall conform to ASTM A325, A325M, A490, or A490M, unless otherwise indicated. For submittal requirements of SI unit bolts, refer to 720S.3 C. Nuts for high strength bolts shall conform to ASTM A563 or A563M and washers shall conform to ASTM F436 or F436M.

B. Unless otherwise indicated, structural steel for secondary members such as shoes, diaphragms, stiffeners, bearing stiffeners, lateral bracing, diagonals, armor joints, and finger joints shall conform to one of the following:

1. ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi (250 MPa).
2. ASTM A500, with a minimum specified yield strength of 46 ksi (315 MPa).

Structural steels used for secondary or nonstress-carrying members will not be subject to

impact requirements.

All steels greater than 0.5 inch (13 mm) in thickness used for structural supports for highway signs, luminaries, and traffic signals shall conform to the longitudinal Charpy V-notch requirements of Table A.

- C. Stud shear connectors, slab anchors, and anchors on armor and finger joints shall conform to ASTM A108, Grades 1015, 1018, or 1020, either semi- or fully-killed, with a minimum specified yield strength of 50 ksi (345 MPa).

D. Piling

Steel piling shall conform to one of the following:

1. ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi (250 MPa).
2. ASTM A252, greater than or equal to 10 gauge, with a minimum specified yield strength of 35 ksi (240 MPa).
3. ASTM A328 (A328M), with a minimum specified yield strength of 39 ksi (270 MPa).
4. ASTM A1011 (A1011M), with a minimum specified yield strength of 33 ksi (230 MPa).

E. Deck Plates

Material for deck plates shall be corrosive-resistant structural steel conforming to ASTM A242 (A242M). The material must be of weldable quality and shall contain alloying elements that furnish corrosion resistance at least twice that of copper bearing structural steel. The type and trade name shall be submitted for review.

F. Rail Posts

Material for rail posts shall conform to ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi (250 MPa).

G. Forgings

Steel forgings from which pins, rollers, trunnions, or other forged parts are to be fabricated shall conform to ASTM A668 (A668M), class C, D, F, or G, with a minimum specified yield strength of 33 ksi (230 MPa). As an alternate for pins four (4) inches in diameter or less, ASTM A108, grades 1016-1030, with a minimum specified yield strength of 36 ksi (250 MPa) may be used.

H. Castings

Steel castings shall conform to ASTM A27 (A27M), Grade 70-36, with a minimum specified yield strength of 36 ksi (250 MPa).

I. Anchor Bolts

Anchor bolts shall conform to one of the following:

1. Plain and threaded bars used for anchorage purposes, ASTM A36 (A36M).
2. Headed bolts and nuts, ASTM A307, Grade A.
3. High strength anchor bolts, ASTM A193 (A193M). Nuts for high strength anchor bolts shall conform to ASTM A194 (A194M).

Anchor bolts shall not be galvanized unless otherwise indicated. When galvanized, anchor bolts and nuts shall be tapped or chased after galvanizing.

When heat treated material is specified or required, the test report for certification shall include the necessary certification relative to the heat treating process.

J. Steel Pipe

Steel pipe shall conform to Item No. 510, "Pipe".

K. Tubing

Steel tubing shall conform to one of the following:

1. ASTM A500, Grade B.
2. API Standard 5L, Grade X52, except as noted herein, may be used if produced by a mill recognized as authorized to produce pipe with the API monogram and listed as such in the standard API specifications. Hydrostatic tests will not be required.

In lieu of the mill test report, a certificate from the manufacturer will be required for each lot or shipment certifying that the tubing meets the requirements stated above.

L. Pipe Rail

Pipe rail shall be construed to include special extruded and bent shapes and shall be of the section indicated. Pipe may be rolled or extruded to the shape indicated or may be cold pressed from a round pipe or flat plate.

If cold pressed, the design of the press and dies shall result in a pipe of uniform section and free from die marks. After the pipe has been formed to the required section, it shall be cut to the lengths required. The end cuts and notches shall be made at such angles with the axis of the pipe as required to produce vertical end faces and plumb posts when indicated. Cutting and notching of pipe shall be done with a saw or machine guided torch or other means that will insure a neat and uniform finish.

M. Deep Beam Rail

Deep beam rail shall conform to AASHTO M180, 10 or 12 gage (exclusive of protective

coating). The terminal connector shall be of the same material, not less than 10 gage. Unless otherwise indicated, the rail element shall be galvanized.

## 720S.5 Miscellaneous Metals

### A. Iron

All iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. Castings shall conform to the following ASTM designations:

1. Malleable iron, ASTM A47 (A47M), grade 35018.
2. Gray iron, ASTM A48 (A48M), class 30 or 35.
3. Ductile iron, ASTM A536, grade 60-40-18 or 65-45-12.

### B. Lead

Sheet lead shall conform to ASTM B29, refined lead or pig.

### C. Copper

Copper strip or sheet shall conform to the following:

1. ASTM B100, alloy 510 or 511.
2. ASTM B152 (B152M).

### D. Aluminum

Unless otherwise indicated, aluminum materials shall conform to the following:

1. Castings, ASTM B108, alloy A444-T4.
2. Extrusions, ASTM B221, alloy 6061-T6.
3. Sheet and plate, ASTM B209, alloy 2024-T3. If welding is required, alloy 6061-T6 can be substituted, but must be heat treated after fabrication and welding.
4. Deep beam rail, ASTM B209, alloy 2024-T3. The minimum thickness of the rail element shall be 0.156 inch (nominal) unless otherwise indicated.

### E. Bronze

Bronze bearing and expansion plates shall conform to ASTM B22, alloy 911.

### 720S.6 Fabrication, Erection, and Painting

Fabrication, erection, and painting of metal for structures shall conform to the following:

- A. Item No. 721S, "Steel Structures".
- B. Item No. 722S, "Paint and Painting". Aluminum or galvanized steel members shall not require painting.
- C. Item No. 723, "Structural Welding".

### 720S.7 Galvanizing

Galvanizing, where indicated, shall conform to the following:

- A. Fabricated items, rolled, pressed or forged steel shapes, plates, pipes, tubular items, and bars, ASTM A123 (A123M).
- B. Steel or iron castings, ASTM A153 (A153M).
- C. Bolts, nuts, screws, washers, and other miscellaneous hardware, ASTM A153 (A153M), Class C or D or ASTM B695, Class 50.

The measurements of thickness and weight of galvanized coating shall be in accordance with TxDOT test method Tex-728-I.

### 720S.8 Measurement

Measurement shall be in accordance with the following:

- A. Weights of supplied metal for structures shall be determined in accordance with Table B:

TABLE B	
Material	Weight [lb./cu. ft. (kg/cu. m)]
Steel	490 (7,849)
Iron, cast	450 (7,208)
Iron, wrought	485 (7,769)
Lead	710 (11,373)
Copper	556 (8,906)
Aluminum	165 (2,643)
Bronze	509 (8,153)

- B. Weights of bolts, nuts, and washers shall be in accordance with the American Institute of Steel Construction's "Steel Construction Manual".
- C. The quantity of metal for structures furnished and placed will be based on the weight of metal in the fabricated structure. The weight of erection bolts, paint or weld metal shall be excluded.
- D. The weights of secondary metals in steel or concrete structures (such as castings, bearing plates, anchor bolts, drains, deck plates, armor joints, and finger joints) for which no separate measurement is specified, shall be in accordance with this specification.

- E. The weights of rolled shapes and plates shall be computed on the basis of their normal weights and dimensions.
- F. The weights of castings will be computed from the dimensions indicated.
- G. Deductions will be made for all cuts, copes, perforations, and all holes except bolt holes.

Splices will be measured as follows:

- A. No additional weight will be allowed for weld metal in a welded splice.
- B. Where a bolted splice is permitted as an alternate for a welded splice, measurement will be made on the basis of a welded splice.
- C. Where a bolted splice is required, the weight of splice material, bolt heads, washers and nuts, with no deduction for holes, will be measured.

A change in design may be required and approved by the Engineer or designated representative, due to unforeseen conditions or other reason, which either increases or decreases the quantity of metal in the completed structure; the increase or decrease in weight will be measured in accordance with this specification and shall be included as a change from the original quantity computed. No adjustment will be made for a change which has not been approved by the Engineer or designated representative and which either increases or decreases the quantity of metal in the completed structure. These changes are subject to approval by the Engineer or designated representative nonetheless to assure that the completed structure is in accordance with the original design intent.

### **720S.9 Payment**

Structural steel for main members will be paid for at the unit price bid per pound for "Structural Steel", "Structural Steel-HS", "Structural Steel-XHS", or such other classification(s) of metal indicated.

Shipping invoice or acceptance slip weights will not be used as basis for payment.

Payment will be made based on the quantity indicated, except as may be modified by the following:

- A. Either party to the contract may request an adjustment of the quantities indicated (by each separate bid item), if the weights calculated in accordance with this specification vary from those indicated by more than the following:
  - 1. Over 500 tons – 0.5 percent.
  - 2. 50 tons through 500 tons – 1 percent.
  - 3. Less than 50 tons – 1.5 percent.

When adjustment is required, the Contractor shall furnish the Engineer or designated representative three sets of shop bills showing the calculated weights of all parts of the

structure. The weights shall be computed from the approved shop drawings, except as noted above. When this quantity is certified correct by the Engineer or designated representative, it will become the revised plan quantity. Quantities revised in this manner will not be subject to the provisions of the "General Conditions".

- B. When quantities are revised by a change in design, the plan quantity will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the "General Conditions".

The unit bid price(s) shall include full compensation for furnishing all materials and for all fabrication, shopwork, transportation, erection, paint, painting, galvanizing, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 720S-A:</b>	Structural Steel	Per Pound.
<b>Pay Item No. 720S-B:</b>	Structural Steel-HS	Per Pound.
<b>Pay Item No. 720S-C:</b>	Structural Steel-XHS	Per Pound.

**End**

SPECIFIC Cross Reference Materials
Specification Item 720S, "Metal for Structures"

City of Austin Standard Specification Items

Designation	Description
Item 510	Pipe
Item 721S	Steel Structures
Item 722S	Paint and Painting
Item 723	Structural Welding

American Association of State Highway and Transportation Officials (AASHTO)

Designation	Description
M180	Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail

American Petroleum Institute (API)

Designation	Description
5L	Line Pipe

American Society for Testing and Materials (ASTM)

Designation	Description
A27/A27M	Standard Specification for Steel Castings, Carbon, for General Application
A36/A36M	Standard Specification for Carbon Structural Steel
A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
A48/A48M	Standard Specification for Gray Iron Castings
A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
A242/A242M	Standard Specification for High-Strength Low-Alloy Structural Steel
A252	Standard Specification for Welded and Seamless Steel Pipe Piles
A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A325M	Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric]
A328/A328M	Standard Specification for Steel Sheet Piling
A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
A490M	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A514/A514M	Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
A517/A517M	Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered
A536	Standard Specification for Ductile Iron Castings
A563	Standard Specification for Carbon and Alloy Steel Nuts
A563M	Standard Specification for Carbon and Alloy Steel Nuts [Metric]
A572/A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A588/A588M	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100-mm] Thick
A668/A668M	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
A673/A673M	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
A709/A709M	Standard Specification for Structural Steel for Bridges
A992/A992M	Standard Specification for Structural Steel Shapes

A1011/A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B22	Standard Specification for Bronze Castings for Bridges and Turntables
B29	Standard Specification for Refined Lead
B100	Standard Specification for Wrought Copper-Alloy Bearing and Expansion Plates and Sheets for Bridge and Other Structural Use
B152/B152M	Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
B108	Standard Specification for Aluminum-Alloy Permanent Mold Castings
B209/B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B221/B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
F436	Standard Specification for Hardened Steel Washers
F436M	Standard Specification for Hardened Steel Washers [Metric]

TxDOT Specifications

Designation	Description
Tex-728-I	Measurements of Dry Film Coating Thickness on Steel

RELATED Cross Reference Materials Specification Item 720S, "Metal for Structures"
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City of Austin Standard Specification Items

Designation	Description
Item 406S	Reinforcing Steel

American Society for Testing and Materials (ASTM)

Designation	Description
A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products