**962 STRUCTURAL STEEL AND MISCELLANEOUS METAL ITEMS (OTHER THAN ALUMINUM).**

**(REV 7-13-22) (FA 8-25-22) (FY 2023-24)**

SECTION 962 is deleted and the following substituted:

**962-1 General.**

This Section covers the material and fabrication requirements for structural steel and miscellaneous metal components. All steel must be melted and manufactured in the United States and meet Section 6-5.2. All overhead cantilevers, monotubes, trusses and gantries, iron castings, steel gratings, fencing, field splices filler metals, and bridge components (including steel castings, steel forgings, and bearing material) supplied under this Specification shall be from producers currently on the Department's Production Facility Listing. Producers seeking inclusion on the Department's Production Facility Listing must meet the requirements of Section 105. Provide certifications that meet the applicable section and 962-12.

**962-2 Structural Steel.**

**962-2.1 Structural Steel Materials:** Provide structural steel for bolted or welded construction that meets the requirements of Table 962-1.1 and 962-1.2 when impact testing is specified. Grade HPS 70W shall not be substituted for Grade HPS 50W. Weathering steel shall not be substituted for non-weathering steel without Engineer approval.

Do not apply heat treatment unless approved by the Engineer. When galvanizing is specified, provide galvanizing in accordance with 962-11.1.

Table 962-1
Structural Steel Materials

| Product | ASTM | Grade/Style | Reportable Properties | Supplementary Requirements |
|---|---|---|---|---|
| Plate | A709 | 36 | Composition, Yield Strength, Tensile Strength, Elongation, Killed | None |
| | | 50 | | |
| | | 50S | | Carbon Equivalency |
| | | 50CR | | Heat-treating temperatures |
| | | 50W | Composition, Yield Strength, Tensile Strength, Elongation, Killed, Fine Grain | Corrosion Resistance Index |
| | | HPS 50W | | Corrosion Resistance Index, Heat Treatment Temperatures |
| | | HPS 70W | | |

**962-2.2Impact Requirements:** Structural steel subject to tensile stress for main load-carrying members shall meet the impact requirements listed in Table 962-2. Mill test reports

shall identify average impact test values. Provide certifications that meet this section and 962-12.

For non-fracture and fracture critical tension components, provide structural steel in accordance with ASTM A709.

Table 962-2
Requirements for Impact Testing Structural Steel

| Product | ASTM | Grade | Zone | Minimum Average Energy (ft*lbf) | |
|---|---|---|---|---|---|
| | | | | Non-Fracture Critical | Fracture Critical |
| Structural Steel | A709 | 36 | 1 | 15 at 70°F | 25 at 70°F |
| | | 50<br>50W<br>50S | | 15 at 70°F (≤ 2.0”t)<br>20 at 70°F (> 2.0”t) | 25 at 70°F (≤ 2.0”t)<br>30 at 70°F (> 2.0”t) |
| | | 50CR | | 15 at 70°F | 25 at 70°oF |
| | | HPS 50W | | 20 at 10°F (≤ 2.0”t)<br>25 at 50°F (> 2.0”t) | 30 at 10°F (≤ 2.0”t)<br>35 at 50°F (> 2.0”t) |
| | | HPS 70W | | 25 at -10°F | 35 at -10°F |
| Structural Steel Tubing | A500 | B, C, D | | 15 at 70°F | 25 at 70°F |
| | A501 | A, B | | | |
| | A847 | Round, Square, Rectangle, Special | | | |

Note: If yield ≥15 ksi above specified grade, test temperature must drop 15°F for each 10 ksi above grade.

**962-3 Steel Castings.**

Provide carbon steel and corrosion resistant castings in accordance with this section and Table 962-3.

**962-3.1 Carbon Steel Castings:** Perform heat treatments by annealing, normalizing, normalizing & tempering, or quenching & tempering after castings have been allowed to cool from the pouring temperature to below the transformation temperature range as regulated by the use of pyrometers. Class 1 castings shall be used if post-weld heat treatment is specified in the contract documents.

**962-3.2 Corrosion Resistant Steel Castings:**
Perform heat treatments by air cooling and tempering; or annealing as defined in ASTM A743 Table 1.

Table 962-3
Requirements for Steel Castings

| Product | Standard | Grade | Class | Reportable Properties | Supplementary Requirements |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Carbon Steel | ASTM A27 | 65-35, 70-36 | 1, 2 | Composition, Tensile, Class | None |
| Corrosion Resistant Steel | ASTM A743 / AASHTO M 163 | CA 15M | All | Composition, Heat Treatment | S11, S12 |

**962-4 Steel Forgings.**

Provide carbon steel and alloy steel forgings from which pins, rollers, trunnions, shafts, gears, or other forged parts are fabricated in accordance with this section and Table 962-4.

The manufacturer may elect to choose from any of the class specific heat treatments identified in the Table 962-4, provided that the controlling cross-sectional thickness meets mechanical property test requirements. Retreatment by re-austenitizing a lot is allowed up to three times when the mechanical properties have not been met. Re-testing of the mechanical properties is required on any lot subject to retreatment.

Table 962-4
Requirements for Steel Forgings

| Product | Standard | Class | Reportable Properties | Supplementary Requirements |
|---|---|---|---|---|
| Steel Forgings | ASTM A668 / AASHTO M 102 | C, D, F, G | Composition, Tensile, Yield, Elongation, Hardness | S7 |

**962-5 Iron Castings.**

Provide iron castings that conform to the requirements of this section and Table 962-5. Use producers listed on the Department's Production Facility Listing for galvanizing.

**962-5.1 Gray Iron Castings:** Provide gray iron castings that conform to the requirements of this section and Table 962-4. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing.

**962-5.2 Ductile Iron Castings:** Perform full ferritizing anneal to remove carbides or stabilized pearlite. AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents.

**962-5.3 Malleable Iron Castings:** Perform heat treatments in the same production furnace and in the same cycles as the castings they represent. Produce a microstructure consisting of temper carbon nodules distributed through a ferritic matrix and free of excessive pearlite, massive carbides, and primary graphite. When critical sections of the production castings differ appreciably from that of the central portion, the time cycle for

tempering may be altered from that of the production lot in order to obtain similar microstructures, or hardness, or both.

When Alternative G castings are specified, provide a composition that precludes the possibility of embrittlement during the normal thermal cycle of hot-dip galvanizing, or provide heat treatment that immunizes the casting against embrittlement during the normal thermal cycle of hot-dip galvanizing.

Table 962-5
Requirements for Iron Castings

| Product | Standard | Grade/Class | Reportable Properties | Supplementary Requirements |
|---|---|---|---|---|
| Gray Iron Traffic Service | AASHTO M 105 & AASHTO M 306 | 35B | Tensile* | None |
| Gray Iron Machinery | AASHTO M 105 | 30 | Tensile | None |
| Ductile Iron | ASTM A536 | 60-40-18 | Tensile*, Yield, Elongation, Heat Treatment | Additional Tensile test for castings > 1,000 lbs. |
| Malleable Iron | ASTM A47 | 30518 [24118] | Tensile, Yield, Elongation, Heat Treatment | None |

*AASHTO HL-93 may be substituted for tensile testing of vaned gratings, when specified in the contract.

**962-6 Bolts, Nuts and Washers Not Designated as High-Strength.**

Provide bolts, nuts, and washers not designated as high strength meeting the requirements listed in this Section and Table 962-6. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.1.

Use double nuts, when ordinary rough or machine bolts are specified in the Contract Documents. Bolted assemblies shall be made of similar coating composition. When weathering material is used, provide the entire assembly in weathering steel. Bolts meeting the requirements of ASTM A193, washers meeting the requirements of ASTM F844 and nuts meeting the requirements of ASTM A194 or AASHTO M292 may be used with the Engineer's approval.

Table 962-6
Bolts, Nuts, and Washers Not Designated as High-Strength

| Product | Standard | Grade | Style | Reportable Properties |
|---|---|---|---|---|
| Bolts | ASTM A307 | A, B | Heavy Hex, Threaded Rod | Size, Composition, Hardness, Tensile |

| Table 962-6<br>Bolts, Nuts, and Washers Not Designated as High-Strength | | | | |
|---|---|---|---|---|
| Product | Standard | Grade | Style | Reportable Properties |
| | ASTM A449 | 1, 3 | Hex, Threaded Stud | Size, Composition, Tensile, Proof Load, Hardness |
| | ASTM F593 | Group 2 316 or 316L | Condition A CW1 or SH1 | Alloy, Group, Condition |
| | ASTM A193* | B7, B16 | Any | Size, Composition, Hardness, Heat Treatment, Macroetch results |
| Nuts | ASTM A563 | A | Hex | Size, Composition, Proof Load, Hardness |
| | | C, C3, DH, DH3 | Heavy Hex | |
| | ASTM F594 | Group 2 316 or 316L | CW | Alloy, Group, Condition |
| | ASTM A194* | 2, 2H | Hex, Heavy Hex | Composition, Hardness, Proof Load |
| | AASHTO M 292* | 2, 2H | Hex, Heavy Hex | Size, Composition, Hardness, Heat Treatment, Macroetch results |
| Washers | ASTM F436 | 1, 3 | Circular, Beveled, Clipped, Extra Thick | Size, Hardness |
| | N/A | 316 or 316L | Any | Alloy, Size |
| | ASTM F844* | Plain | Round, Miscellaneous | Size |
| | ASTM A36 | All | N/A | Killed, Thickness |
| Shims | ASTM A1011 | Any | Any | None |
| | ASTM A109 | Any | Any | None |
| | ASTM B36 | Brass | Any | None |

**962-7 High-Strength Bolts, Nuts, Washers and Direct-Tension-Indicator (DTI) Devices.**

Provide high-strength bolts, nuts, washers and DTI devices in accordance with this Section and Table 962-7. High-strength bolts shall have identifying marks meeting ASTM F3125 Table 2 and ASTM A563. High-strength bolted assemblies shall be made of

similar coating composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with 962-11.3.2. Bolts meeting the requirements of ASTM F3125 Grade A490, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 or AASHTO M 292 may be used with the Engineer's approval.

Table 962-7
Requirements for High-Strength Steel Fastener Assemblies

| Products | Standard | Grade | Type/ Style | Reportable Properties | Supplementary Requirements |
|---|---|---|---|---|---|
| Bolts | ASTM F3125 | A325 | Heavy Hex | Size, Composition, Tensile, Proof Load, Hardness, | None |
| | | A490* | | Size, Composition, Tensile, Proof Load, Hardness, Magnetic Particle, Carburization/ Decarburization | |
| | ASTM A193 | B7, B16 | Any | Size, Composition, Hardness, Heat Treatment, Macroetch results | S5 |
| Nuts | ASTM A563 | DH, DH3 | Heavy Hex | Size, Composition, Proof Load, Hardness | S1, S2 min. 89 HRB or 180 HB |
| | ASTM A194* | 2H | Heavy Hex | Size, Composition, Hardness | Max HRC32 |
| | AASHTO M 292* | 2H | Heavy Hex | Size, Composition, Hardness, Heat Treatment, Macroetch results | Max HRC32 |
| Washers | F436 | Circular, Beveled, Clipped, Extra Thick | 1, 3 | Size, Hardness | None |
| | F844* | Round, Miscella neous | Plain | Size | None |
| | ASTM A709 | 36, 50 | Any | Yield, Tensile, Elongation, Killed | None |
| DTI Devices | F959 | A325 | 1 | Size, Composition, Compression Load, Hardness | None |

| Table 962-7<br>Requirements for High-Strength Steel Fastener Assemblies | | | | | |
|---|---|---|---|---|---|
| Products | Standard | Grade | Type/ Style | Reportable Properties | Supplementary Requirements |
| | | | 3 | Size, Composition, Compression Load, Hardness, Corrosion Resistance Index | |
| *Requires Engineer Approval. | | | | | |

**962-8 Anchor Rods and Bridge Bearing Materials.**

**962-8.1 Bearing and Masonry Plate:** Meet the requirements of Table 962-8. Masonry plates and bearings shall be welded in accordance with AASHTO/AWS D1.5 Bridge Welding Code. When galvanizing is specified meet the requirements of 962-11.1. Use producers listed on the Department's Production Facility Listing for galvanizing.

| Table 962-8<br>Requirements for Bearings and Masonry Plate | | | | | |
|---|---|---|---|---|---|
| Product | ASTM | Grade | Style | Reportable Properties | Supplementary Requirements |
| Plate | A709 | 50W | All | Yield, Tensile, Elongation, Killed, Fine Grain | Corrosion Resistance Index |
| Laminates | A240 | 316 | Gage 16 | Yield, Tensile, Elongation, Hardness | None |
| | A1011 | 36 | HSLAS, Class 1 | Designation, Style | None |
| | A36 | All | All | Yield, Tensile, Elongation, Killed | None |

**962-8.2 Anchor Rods and Bearing Hardware:** Provide anchor rods and other bearing hardware in accordance with this section and Table 962-9. All fastening components shall be made of similar composition. When galvanizing is specified in the contract documents, provide galvanizing in accordance with Section 962-11.3.1. Anchor rods meeting the requirements of ASTM A307, washers meeting the requirements of ASTM F844, and nuts meeting the requirements of ASTM A194 may be used with the Engineer's approval.

| Table 962-9<br>Requirements for Anchor Rods and Bearing Hardware | | | | | |
|---|---|---|---|---|---|
| Product | ASTM | Grade | Style | Reportable Properties | Supplementary Requirements |
| Bolts | F1554 | 36 | | Lot, Size, Tensile | None |

| Table 962-9<br>Requirements for Anchor Rods and Bearing Hardware | | | | | |
|---|---|---|---|---|---|
| Product | ASTM | Grade | Style | Reportable Properties | Supplementary Requirements |
| | | 55 | Threaded Rod | Lot, Size, Tensile, Carbon Equivalency | S1 |
| | | 105 | | Lot, Size, Tensile, Carbon Equivalency | S3 |
| | A307* | A, B | Threaded Rod | Size, Composition, Hardness, Tensile | S1 |
| Nuts | A563 | DH | Heavy Hex | Size, Composition, Proof Load, Hardness | None |
| | A194* | 2H | Heavy Hex | Size, Composition, Hardness | None |
| Washers | F436 | 1, 3 | Circular, Beveled, Clipped, Extra Thick | Size, Hardness | None |
| | F844* | Plain | Round, Miscellaneous | Size | None |
| Plate | A36 | All | All | Yield, Tensile, Elongation, Killed | None |
| Shim | A653 | All | Min. G30 | Grade | None |
| | A1008 A36 | All | A153, F2329 | None | None |
| *Requires Engineers Approval. | | | | | |

**962-9 Overhead Signs.**

Provide overhead sign materials in accordance with this section Table 962-2, and Table 962-10. When galvanizing is specified, meet the requirements of 962-11.1. Produce welds using E7018 electrode, in accordance with AWS D1.1 Structural welding Code.

| Table 962-10<br>Requirements for Overhead Signs | | | | | |
|---|---|---|---|---|---|
| Product | Standard | Grade | Type/ Style | Reportable Properties | Supplementary Requirements |
| Upright Pipe | API 5L | X42R, X42N, X42M, X46N, X46M, | PSL2 | Killed, Fine Grain, Tensile, CVN Test | N/A |

| Table 962-10<br>Requirements for Overhead Signs | | | | | |
|---|---|---|---|---|---|
| Product | Standard | Grade | Type/ Style | Reportable Properties | Supplementary Requirements |
| | | X52N, X52M, X56N, X56M, X60N, X60M, X65M, X70M | | | |
| | A500 | B, C | Round Structural | Composition, Yield, Tensile, Elongation | UT Seam Weld, (per API 5L) CVN Test per 962-2 |
| Chords | A500 | B, C | Round Structural | Composition, Yield, Tensile, Elongation | N/A |
| Plate, Angles & Handhole Frame | A709 | 50 | Plates & Shapes | Composition, Yield, Tensile, Elongation | N/A |
| | A36 | 36 | | | Yield > 50ksi |
| Poles | A1011 | 50, 55, 60, 65 | Any | Designation, Grade | N/A |
| | A572 | 50, 55, 60, 65 | 1, 2, 3, 5 | Composition, Tensile, Type, Killed | N/A |
| | A595 | A, B | Any | Composition, Tensile, Type, Killed | N/A |

**962-10 Miscellaneous Metal Items.**

**962-10.1 General:** Unless otherwise specified in the contract documents, provide miscellaneous metal components in accordance with this section and Table 962-11, Table 962-12, Table 962-13, or Table 962-14. Structural tubing subject to tensile stresses, as defined in Section 460, shall meet Table 962-2.2 for tension components, Zone 1. Welding shall be done in accordance with the most current AWS D1.1 structural welding code. When galvanizing is specified in the contract documents, provide galvanizing in accordance with the contract documents.

Requirements for concrete reinforcement are contained in Section 931.

Requirements for steel guardrail are contained in Section 967.

| Table 962-11<br>Requirements for Miscellaneous Metals | | | | |
|---|---|---|---|---|
| Product | Standard | Grade | Type/<br>Style | Reportable Properties |
| Steel Sheet Piling | A328 | All | Cold Rolled, Heat Treated | Composition, Tensile, Killed |
| | A572 | 42, 50, 55, 60, 65 | 1, 2, 3, 5 | Composition, Tensile, Size, Killed |
| | A690 | All | All | Composition, Tensile, Killed |
| Steel Pipe Piling | A252 | 3 | All | Composition, Tensile, Size |
| | API 5L | X46, X52, X56, X60, X65, X70 | PSL1 | Tensile |
| | | | PSL2 | Killed, Fine Grain, Tensile |
| Structural Tubing | A500 | Round | B, C | Composition, Tensile, Flattening Test, Impact (Zone 1), Size |
| | | Shaped | | Composition, Tensile, Impact (Zone 1), Size |
| | A501 | Square, Round, Rectangular, Special | A, B | Composition, Tensile, Impact (Zone 1), Size |
| | A847 | Round | Welded, Seamless | Composition, Tensile, Flattening, Impact (Zone 1), Size |
| | | Square, Rectangle, Special | Welded, Seamless | Composition, Tensile, Impact (Zone 1), Size |
| Pipe Railing | A53 | A, B | E, S | Composition, Mechanical Testing (Tensile, Bend, Flattening), Size |

**962-10.2 Field Splice Filler Materials:** Provide field splice filler materials in accordance with the contract documents. If unspecified and less than 3/16 inches thick filler splice materials in accordance with this section and Table 962-12. Filler plates may also meet the appropriate grades specified in 962-2. When galvanized plate is specified, use producers listed on the Department's Production Facility Listing for galvanizing.

| Table 962-12<br>Requirements for Field Splice Filler Materials | | | | |
|---|---|---|---|---|
| Product | Standard | Grade | Type/<br>Style | Reportable Properties |
| Filler Sheet | A1011 | 50 | HSLAS, Class 1 | Designation, Grade |

**962-10.3 Fencing Material:** Provide fencing materials in accordance with this section and Table 962-13. When galvanizing is specified, provide galvanizing in accordance with the contract documents. Use producers listed on the Department's Production Facility Listing for Coated Steel Fencing.

Table 962-13
Material Requirements for Fencing

| Product | Standard | Grade / Type | Style | Reportable Properties |
|---|---|---|---|---|
| Fabric | A116 | 60 | No. 9 | Breaking Strength, Coating Weight |
| | | 175 | No. 12-1/2 | |
| | A584 | 175 | No. 12-1/2 | |
| | M181 | 1, 2, 4 | No. 9 | |
| | A392 | All | No. 9 | |
| | A491 | All | No. 9 | |
| | F668 | All | No. 9 | |
| Posts | A702 | 50 | Carbon, Rail | Tensile or Hardness |
| Pipe, Tube | A53 | A, B | E, F, S | Grade, Finish |
| | F1083 | Schedule 40 | High Strength | Schedule |
| | F1043 | 1C | All | Group, Coating, Type |
| | | 1A | High strength | |
| Beam | A36 | 36 | All Shapes | Grade, Killed |
| | A572 | 42 | | |
| | A992 | 50 | | |
| Sheets | A1011 | 36, 45, 50 | HSLAS, HSLAS-F, SS | Designation, Style |

**962-10.4 Steel Grates:** Provide steel grating in accordance with this section and Table 962-14. When vaned gratings are specified, AASHTO HL-93 load testing may be substituted for tensile testing when specified in the contract documents. When Alternate G is specified, provide galvanizing in accordance with 962-11.1.

Use producers listed on the Department's Production Facility Listing for galvanizing.

| Table 962-14<br>Requirements for Steel Grating | | | | |
|---|---|---|---|---|
| Product | Standard | Grade | Type/<br>Style | Reportable Properties |
| Steel Grating | A242 | 50 | 1 | Composition, Tensile*, Killed |
| | A572 | | 1, 2, 3, 5 | Composition, Tensile*, Size, Killed |
| | A588 | | A, B, K | Composition, Tensile*, Fine Grain |
| | A1011 | Any | SS, HSLAS, HSLAS-F | Designation, Style |
| * AASHTO HL-93 may be substituted for tensile testing for vaned gratings when specified. | | | | |

**962-11 Galvanizing.**

**962-11.1 Plates, Structural Shapes, Bars, and Strip:** When galvanizing is specified in the Contract Documents for ferrous metal products, provide galvanizing in accordance with the requirements of ASTM A123, Zinc composition shall meet "Intermediate Grade" in accordance with ASTM B6. Use galvanizers listed on the Department's Production Facility Listing for hot-dip galvanizing.

| Table 962-15<br>Requirements for Galvanizing Bath Composition | | | |
|---|---|---|---|
| Product | Zinc (Zn) | Lead (Pb) | Tin (Sn) |
| Galvanizing Bath | ≥ 99.00% | ≤ 0.50% | ≤ 0.10% |

**962-11.2 Castings:** When Alternative G castings are specified in the contract documents, provide galvanizing in accordance with the requirements of ASTM A123. Zinc composition shall meet 962-11.1.

**962-11.3 Fasteners and Hardware:**

**962-11.3.1 Fasteners and Hardware Designated Not High-Strength:** When zinc coating is required in the contract documents provide galvanizing of stell or malleable iron in accordance with the requirements of ASTM A153.

**962-11.3.2 Fasteners and Hardware Designated as High-Strength:** When zinc coating is required in the Contract Documents, provide galvanizing in accordance with Table 962-16. Coating of ASTM F3125, A490 bolts is prohibited. Bake all hot dipped or electroplated bolt, rod, or bar with a tensile strength greater than or equal to 150 ksi to remove any residual hydrogen.

| Table 962-16<br>Coating Requirements for Fastener and Hardware Designated as High-Strength | | | | |
|---|---|---|---|---|
| Product | ASTM | Grade | Type/Style | Coating Finish |
| Bolts | F3125 | A325 | 1 | ASTM B695, Class 55 |

| Table 962-16<br>Coating Requirements for Fastener and Hardware Designated as High-Strength | | | | |
|---|---|---|---|---|
| | | | | ASTM F2329 |
| | | A490 | All | Do Not Galvanize |
| Anchor Rods | F3125 | A325 | 1 | ASTM B633 SC 3, Type II |
| | | A490 | All | Do Not Galvanize |
| | F1554 | 105 | All | ASTM B633 SC 3, Type II |
| Anchor Rods | F1554 | 36, 55 | All | ASTM B695 Class 55<br>ASTM F2329 |
| Nuts | A563 | A, C, D, C3, DH, DH3 | Hex, Heavy Hex | |
| | A194 | 1, 2 | All | |
| Washers | F436 | Circular, Beveled, Clipped, Extra Thick | 1 | |
| | F844 | Round, Miscellaneous | A | |
| DTI Devices | F959 | A325 | 1 | |

**962-12 Certifications and Verification.**

**962-12.1 General:** Provide certifications for steel directly from the Mill. Mill certifications shall show compliance to the specification and include the reportable properties and supplementary requirements from the applicable sections listed above.

When secondary processing, or testing has occurred, in addition to the mill certificate, provide a certified mill analysis signed by a quality control representative that show compliance with and the test results of the applicable sections listed above.

When material meeting “Buy America” is specified, the mill certification or certified mill analysis shall identify that the included material meets the Source of Supply-Steel requirements in Section 6.