SECTION 713 - STRUCTURAL STEEL AND RELATED MATERIALS

713.01 Structural Steel.

(A) Carbon Structural Steel.

(1) Carbon structural steel shall conform to ASTM A 36.

(2) Steel for eyebars shall be weldable grade and shall include the following:

(a) Carbon structural steel conforming to ASTM A 36.

(b) High-strength low-alloy structural steel conforming to ASTM A 242.

(c) High-strength low-alloy columbium-vanadium structural steel conforming to ASTM A 572.

(B) High-Strength Low-Alloy Structural Steel. High-strength low-alloy structural steel shall conform to ASTM A 242, ASTM A 572, or ASTM A 588.

(C) High-Strength Low-Alloy Structural Steel for Welding. High-strength low-alloy structural steel shall be weldable grade and shall conform to ASTM A 242 or ASTM A 572.

(D) High-Strength Low-Alloy Structural Steel for Riveted or Bolted Construction. High-strength low-alloy structural steel for riveted or bolted construction shall conform to ASTM A 572 or ASTM A 588.

713.02 Welded Stud Shear Connectors. Stud shear connectors shall be of design suitable for end welding to steel beams and girders with automatically timed stud-welding equipment. Type, size or diameter, and length of stud shall be as specified in the plans.

Arc shield (ferrule) of heat-resistant ceramic or other material shall be furnished with each stud used in shop or in field. Material shall not be detrimental to welds or cause excessive slag to form and shall have sufficient strength so as not to crumble or break as result of thermal or structural shock before weld is completed.

Flux for welding shall be furnished with each stud, by attachment to end of stud or combined with arc shield for automatic application during welding.

Studs shall not be painted or zinc coated.

Studs shall pass stud qualification procedure prescribed in AWS D1.5. Arc shield used in production shall be same as that used in qualification tests. Stud

qualification shall be accomplished before use and shall be provided at no increase in contract price or contract time.

Shear connector studs shall conform to AASHTO M 169, Grades 1015, 1018, or 1020. If flux-retaining caps are used, steel for caps shall be low-carbon grade suitable for welding conforming to ASTM A 109.

Tensile properties established by tests of bar stock after drawing or tests of finished studs shall conform to Table 713.02-1 - Tensile Properties.

TABLE 713.02-1 TENSILE PROPERTIES

Tensile Strength, psi (minimum)	60,000
Yield Strength[1], psi (minimum)	50,000
Elongation, percent in 2 inches (minimum)	20
Reduction of Area, percent (minimum)	50

[1] As established by 0.2 percent offset method.

Tensile properties shall be determined in accordance with ASTM A 370. Tensile tests of finished studs shall be done on studs welded into test plates using test fixture specified in Article 11.3.3.2 of AASHTO *LRFD Bridge Construction Specifications*. If fracture occurs outside of middle half of gage length, test shall be repeated.

Finished studs shall be of uniform quality and condition, free of laps, fins, seams, cracks, twists, bends, and other injurious defect. Finish shall be produced by cold drawing, cold rolling, or machining.

Manufacturer shall certify that studs delivered to the project meet requirements of this subsection. Certified copies of in-plant quality control test reports shall be submitted upon request.

The Engineer reserves the right to test studs of each type and size for conformance to requirements of this subsection.

Before installation of studs, the Contractor shall submit the following:

(A) Name of manufacturer.

(B) Detailed description of stud and arc shield.

(C) Certification from manufacturer that stud meets qualification requirements in accordance with Article 11.3.3.4 of AASHTO *LRFD Bridge Construction Specifications*.

(D) Notarized copy of qualification test report certified by testing laboratory.

After welding, studs shall be free of defect and substance that will inhibit function as shear connectors.

713.03 (Unassigned).

713.04 (Unassigned).

713.05 Pins and Rollers. Pins and rollers shall be turned accurately to dimensions indicated in the contract documents. Pins and rollers shall be straight, smooth, and free of flaws.

Pins and rollers more than 9 inches in diameter shall be forged and heat-treated in accordance with Article 11.4.9 of AASHTO *LRFD Bridge Construction Specifications*. Pins and rollers 9 inches or less in diameter may be forged and heat treated, or fabricated from cold-finished carbon-steel shafting.

Pins larger than 9 inches in diameter shall be bored with a hole 2 inches or more in diameter for full length of pin along its axis. Hole shall not be bored until pin has been allowed to cool after forging to temperature below critical range under suitable conditions.

713.06 (Unassigned)

713.07 Steel Forgings and Steel Shafting.

(A) Carbon Steel Forgings. Carbon steel forgings shall conform to AASHTO M 102, Class C.

(B) Cold-Finished Carbon Steel Shafting. Cold-finished carbon steel shafting shall conform to AASHTO M 169, Grades 1016 to 1030.

713.08 Steel Castings.

(A) Carbon Steel Castings. Carbon steel castings shall conform to AASHTO M 103, Grade 65-35, Class 2.

Carbon steel castings shall be thoroughly annealed and shall be:

(1) True to pattern in form and dimensions.

(2) Free of pouring faults.

(3) Free of sponginess.

(4) Free of cracks.

(5) Free of blowholes.

(6) Free of other defect that may impair strength and service value.

Blowholes in finished castings shall be checked for acceptability with straight edge. Cavities shall not exceed one inch per 12 inches in any direction when measured with straight edge. Single cavity shall not be larger than one inch in size and 0.5 square inch in area. Depth of blowhole shall not adversely diminish strength of steel casting. Repair of minor defects by welding will be allowed if welding does not impair strength of casting and the Engineer has accepted method of welding.

Defects shall be removed from solid metal by chipping, drilling, or other accepted method. After removal of defect, welding shall fill depression until weld metal protrudes at least 1/8 inch above surface of casting. Weld metal deposits shall be sound throughout and free of excessive oxides, non-metallic intrusions, and gas pockets. Weld metal shall penetrate full depth of recess and thoroughly fuse with base metal along surface and edges of weld. Weld deposit shall edge into base metal with gradual taper and no overlap. Thickness of base metal along edges of removed section shall not be reduced as result of welding process. Welding shall be done only by qualified operators using proper equipment in good working condition.

Welded castings that have not been inspected or accepted by the Engineer will not be allowed.

If necessary, large castings shall be hung and hammered throughout. Cracks, flaws, and other defects that may result will be cause for rejection.

Sharp, unfilleted angles or corners in casting will not be allowed.

(B) Iron-Chromium-Nickel Castings. Chromium-alloy steel castings shall conform to AASHTO M 163, Grade CA15; or ASTM A 744, Grade CD-4MCu.

713.09 Gray Iron Castings. Gray iron castings shall conform to ASTM A 48, Class No. 30.

Gray iron castings shall be:

(A) True to pattern in form and dimensions.

(B) Free of pouring faults.

(C) Free of sponginess.

(D) Free of cracks.

(E) Free of blowholes.

(F) Free of other defect that may impair strength and service value.

Castings shall be boldly filleted at angles. Arises shall be sharp and perfect.

Castings shall be sandblasted and cleaned of scale and sand to present smooth, clean, and uniform surface.

713.10 Malleable Iron Castings. Malleable iron castings shall conform to ASTM A 47, Grade No. 22010.

Malleable iron castings shall be:

(A) True to pattern in form and dimensions.

(B) Free of pouring faults.

(C) Free of sponginess.

(D) Free of cracks.

(E) Free of blowholes.

(F) Free of other defect that may impair strength and service value.

Castings shall be boldly filleted at angles. Arises shall be sharp and perfect. Surfaces shall be finished in accordance with the contract documents.

Castings shall be sandblasted and cleaned of scale and sand to present smooth, clean, and uniform surface.

END OF SECTION 713