

SECTION 715 - ALUMINUM**715.01 Aluminum.**

(A) Columns, Crossarms, Truss Chords, and Braces. Columns, crossarms, truss chords, and braces shall be from extruded aluminum tubing, ASTM B 221, Alloy 6061-T6. Tubing shall be free of discoloration, nicks, and blemishes resulting from improper packing and handling.

(B) Aluminum Plates. Aluminum plates and sheets shall be of ASTM B 209, Alloy 6061-T6.

(C) Aluminum Structural Shapes. Aluminum standard structural shapes shall be rolled or extruded, and shall be of ASTM B 308, Alloy 6061-T6.

(D) Aluminum Washers. Aluminum washers shall be of ASTM B 209, Alloy 2024-T4. Spring lockwashers of aluminum shall conform to ASTM B 211, Alloy 7075-T6.

(E) Aluminum Shims. Aluminum shims shall be of ASTM B 209, Alloy 1100-O.

(F) Aluminum Castings. Aluminum for post bases shall conform to ASTM B 26, Alloy 356-T6. Material for splicing flanges, when cast, shall conform to ASTM B 26, Alloy 356-T7. Material for post caps, when cast, shall conform to ASTM B 26, Alloy 356-F.

715.02 Contacts With Dissimilar Material. Where aluminum alloy parts are to be placed in contact with, or are to be fastened to, steel members or other dissimilar materials, aluminum shall be kept from direct contact with steel or other dissimilar materials by painting as follows:

(A) Steel surfaces to be placed in contact with uncoated aluminum shall be painted with one coat of zinc-molybdate, alkyd type primer in accordance with Federal Specification TT-P-645B, followed by two coats of paint consisting of two pounds of aluminum paste pigment per gallon of varnish. Aluminum paste pigment shall conform to ASTM D 962, Type 2, Class B. Varnish shall conform to Federal Specification TT-V-81G, Type II.

(B) Surfaces of stainless steel, aluminized steel, hot-dip zinc-coated steel, or electrogalvanized steel to be placed in contact with aluminum shall not be painted unless otherwise indicated in the contract documents.

(C) Aluminum shall not be placed in direct contact with wood, fiberboard, or other porous material that absorbs water and causes corrosion. When such contacts cannot be avoided, an insulating barrier between aluminum and porous material shall be installed.

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Aluminum surfaces to be placed in contact with wood, fiberboard, or other porous material; or in contact with concrete or masonry, shall be given one heavy coat of alkali-resistant bituminous paint before installation. Bituminous paint shall conform to Military Specification MIL-P-6883. Paint shall be applied as received from manufacturer without adding thinner. Aluminum embedded in concrete shall be painted in accordance with Subsection 715.02(D).

(D) Aluminum surfaces to be embedded in concrete shall be painted with one coat of zinc-molybdate primer in accordance with Federal Specification TT-P-645B. Aluminum shall not be embedded in concrete to which corrosive components such as chlorides have been added if aluminum will be electrically connected to steel.

(E) Aluminum shall not be exposed to water that has come in contact with heavy metal, such as copper. Heavy metal shall be painted or coated with plastic; or drainage from the heavy metal shall be diverted away from the aluminum.

715.03 Fabrication of Welded Aluminum Structures. Welding terms used in this subsection shall be interpreted in conformance with AWS A3.0. Welding symbols used in the contract documents, if any, shall conform to AWS A2.4.

(A) Base Metal. Material used for permanent backing shall be at least equivalent in weldability to base metal being welded.

(B) Welding Process. Welding shall be by gas metal arc process and gas tungsten arc process.

(C) Filler Metal.

(1) Bare wire electrodes for use with gas metal arc process and welding rods for use with gas tungsten arc process shall conform to AWS A5.10.

(2) Tungsten electrodes for gas tungsten arc process shall conform to AWS A5.12.

(3) Filler metals to be used with particular base metals shall conform to *Specifications for Aluminum Structures*, issued by The Aluminum Association.

(4) Filler metals shall be kept covered and stored in dry place at relatively uniform temperature. Original rod or wire containers shall not be opened until time of use. Rods and wire shall be free of moisture, lubricant, and other contaminants. Spools of wire temporarily left unused on welding machine shall be kept covered to

97 avoid contamination by dirt and grease collecting on wire. Unused
98 spool of wire shall be returned to its carton and resealed tightly.
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100 **(D) Shielding Gases.**

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102 **(1)** Shielding gases shall be welding grade or better.
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104 **(2)** Shielding gas for gas metal arc welding shall be argon, helium,
105 or mixture of the two gases. Mixture shall be at least 50 percent
106 helium.
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108 **(3)** Shielding gas for gas tungsten arc welding using alternating
109 current shall be argon.
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111 **(4)** Shielding gas for gas tungsten arc welding using direct current,
112 straight polarity, shall be helium.
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114 **(5)** Hose used for shielding gases shall be synthetic rubber or
115 plastic. Natural rubber hose and hose previously used for acetylene
116 or other gases shall will not be allowed.
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118 **(E) Preparation for Welding.**

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120 **(1)** Joint details shall be in accordance with the contract
121 documents.
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123 **(2)** Edge preparation for welding shall be by sawing, machining,
124 clipping, shearing, or gas tungsten arc or gas metal arc cutting. Cut
125 surfaces shall conform to the ANSI Standards surface roughness
126 rating value of 1,000. Oxygen cutting shall will not be allowed.
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128 **(3)** Surfaces and edges to be welded shall be free of fins, tears,
129 and other defects that would adversely affect quality of weld.
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131 **(4)** Dirt, grease, forming or machine lubricants, or organic
132 materials shall be removed from areas to be welded by cleaning with
133 solvent or by vapor degreasing.
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135 **(5)** Just before welding, oxides shall be removed from edges and
136 surfaces to be welded, by wire brushing or by other mechanical
137 method, such as rubbing with steel wool or abrasive cloth, scraping,
138 filing, rotary planing, or sanding. If removal is by wire brushing,
139 brushes shall be stainless steel. Hand or power driven wire brushes
140 that have been used on other material shall not be used on aluminum.
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142 **(6)** If mechanical methods of oxide removal are inadequate,
143 standard chemical method shall be used. Welding shall be done
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(7) If gas tungsten arc welding with direct current, straight polarity, is used, oxide shall be removed by standard chemical method from edges and surfaces that are to be welded.

(8) Welding shall not be done on anodically treated aluminum, unless treatment has been removed from joint area to be welded.

(F) Welding Procedure.

(1) Butt welds, except those produced with aid of backing, shall have root of initial weld chipped or machined to sound metal before welding is started from second side. Butt welds made with use of backing shall have weld metal thoroughly fused with backing. If accessible, backing for welds that are subject to computed stress and are not part of structure, or exposed to view from completed structure and are not part of structure, shall be removed and joints shall be ground or machined smooth.

For tubular members, butt welds that are subject to computed stresses shall be made with assistance of permanent backing rings or strips.

(2) Production welding of a particular joint shall follow same procedure used to qualify the joint.

(3) Welding operations, either shop or field, shall be protected from air currents and drafts to prevent loss of gas shielding during welding. Adequate gas shielding shall be provided to protect molten metal during solidification.

(4) Flat position welding shall be provided whenever practicable.

(5) In shop and field, joints shall be welded only when dry.

(6) Size of electrode, voltage, amperage, welding speed, gas or gas mixture, and gas flow rate shall be suitable and determined by the following:

(a) Thickness of material.

(b) Joint design.

(c) Welding position.

(d) Other circumstances affecting work.

- 192 (7) Gas metal arc welding shall be done with direct current,
193 reverse polarity.
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- 195 (8) Gas tungsten arc welding shall be done with alternating current
196 or with direct current, straight polarity.
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- 198 (9) If joint to be welded requires specific root penetration, the
199 Contractor shall provide sample joint and macro-etched cross section
200 of weld. Sample joint shall have minimum length of 12 inches and
201 shall be welded with same electrode, polarity, amperage, voltage,
202 speed, gas mixture, and gas flow rate as proposed in production
203 welds. The Contractor shall demonstrate by testing that proposed
204 joint welding procedure will attain required root penetration. The
205 Engineer will use discretion to accept evidence on record as
206 alternative to tests.
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- 208 (10) If preheating is required, preheat temperature shall not exceed
209 250 degrees F for heat-treated alloys or 5000-series aluminum-
210 magnesium alloys containing more than 3 percent magnesium; and
211 600 degrees F for alloys that are not heat-treated. Temperature shall
212 be measured by temperature-indicating crayons or pyrometric
213 equipment. Heat-treated alloys shall not be maintained at maximum
214 preheat temperature or near-maximum temperature for more than 15
215 minutes.
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217 **(G) Weld Quality.**
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- 219 (1) The following weld conditions will be cause for rejection:
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- 221 (a) Cracks in welds or adjacent base metal.
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 - 223 (b) Copper and slag inclusions.
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 - 225 (c) Porosity over that permitted by AWS D1.2.
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- 227 (2) Acceptable depth of undercut shall be as follows:
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- 229 (a) Not more than 0.01 inch when direction of undercut is
230 transverse to primary stress in part that is undercut.
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 - 232 (b) Not more 0.03 inch when direction of undercut is parallel
233 to primary stress in part that is undercut.
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- 235 (3) Overlaps will not be allowed.
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- 237 (4) Craters shall be filled to full cross section of welds.
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239 (5) Defective welds that do not meet acceptance requirements of
240 this subsection will be rejected, unless corrective measures are taken
241 in accordance with Subsection 715.03(I) - Corrective Measures.
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(H) Inspection.

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245 (1) The Contractor shall inspect welds visually for conformance to
246 Subsection 715.03(G) - Weld Quality. Additionally, the Contractor
247 shall test butt welds in columns and main members of highway sign
248 bridges by radiographic or ultrasonic method for entire length of weld
249 when welded sections are main, stress-carrying members subject to
250 tension or stress reversal, as determined by the Engineer.
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252 (2) For highway sign structures, dye-penetrant test method shall
253 be used on the following:
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255 (a) Fillet welds connecting columns to bases and main
256 chord members, including associated flanges, gussets, or main
257 load-carrying brackets or members.
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259 (b) Fillet welds connecting flanges to main truss chord
260 members.
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262 (3) On pole type and common light standards, dye-penetrant
263 method shall be used on butt welds in columns and on fillet welds
264 connecting columns to bases.
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266 (4) Dye-penetrant test shall be done in accordance with ASTM
267 E 165, Method B, Procedure B-2 or B-3.
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269 (5) The Engineer may omit requirement for dye-penetrant
270 inspection if the Contractor examines each layer of weld metal for
271 weld defects, with magnifier of 3X minimum power before depositing
272 successive layers.
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(I) Corrective Measures. Allowable corrective measures are as follows:

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276 (1) Defective welds shall be corrected by removing and replacing
277 entire weld.
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279 (2) Specific defects can be corrected as follows:
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281 (a) **Cracks in Welds of Base Metal.** Dye-penetrant
282 method or other positive means shall be used to determine full
283 extent of crack. Crack shall be removed for its entire length
284 and depth. Connection shall be rewelded.
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286 (b) **Excessive Porosity or Lack of Fusion.** Defective
287 portions shall be removed. Connection shall be rewelded.

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289 (c) **Copper or Tungsten Inclusion.** Defective portions
290 shall be removed. Connection shall be rewelded.

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292 (d) **Excessive Concavity of Crater, Undercut, or**
293 **Undersized Weld.** Defective section shall be cleaned.
294 Additional weld metal shall be deposited.

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296 (e) **Overlap.** Overlap shall be reduced by removing excess
297 weld metal.

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299 (3) Defective areas shall be removed by chipping or machining.
300 Oxygen cutting will not be allowed. Joint shall be inspected to ensure
301 removal of all defective welds before rewelding. If dye penetrant was
302 used to inspect weld, traces of penetrant solution shall be completely
303 removed with solvent, water, heat, or other suitable means before
304 rewelding.

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306 (J) **Qualification of Procedures, Welders, and Welding Operators.**

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308 (1) Joint welding procedures to be used by the Contractor shall be
309 qualified by testing in accordance with AWS D1.2. The Contractor
310 shall provide testing at no increase in contract price or contract time.
311 The Engineer will use discretion to accept previous qualified welding
312 procedures proposed to be used.

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314 (2) Welders and welding operators to be used by the Contractor
315 shall be qualified by testing in accordance with AWS D1.2. The
316 Contractor shall provide testing at no increase in contract price or
317 contract time. The Engineer will use discretion to accept welders and
318 welding operators who were qualified previously. Process and type of
319 equipment proposed for construction shall be same as those used to
320 qualify welders and welding operators.

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END OF SECTION 715