



## SECTION 1037

### SHEAR CONNECTORS

**1037.1 Scope.** This specification covers the requirements for stud-type shear connectors and weldability qualification.

**1037.2 Material.** Studs shall be in accordance with AASHTO M 169 for cold drawn carbon steel bars Grades 1015, 1017 or 1020, either semi- or fully-killed. If flux retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall be in accordance with ASTM A 109. The flux for welding shall be self-contained either in the base of the stud or in the ferrule and automatically applied in the welding operation. A ferrule of heat resistant ceramic or other suitable material shall be used with each stud, and the ferrule shall be composed of material, which is not detrimental to the welds, does not cause excessive slag and has sufficient strength to withstand thermal or structural shock.

**1037.3 Qualification Procedure.** The procedure for weldability tests to qualify shear connector studs for welding under shop or field conditions shall be as follows. Such tests may be performed by a university, independent laboratory or by other approved testing agencies. The tests shall be made on each type and size of stud. The agency performing the tests shall submit to the manufacturer of the stud a certified report giving procedures and results for all tests, including the information listed under [Sec 1037.9](#).

**1037.4 Duration of Qualification.** Qualifications will be considered valid until the manufacturer makes a change in the base of the stud, the flux or the arc shield, which affects the welding characteristics.

#### 1037.5 Preparation of Specimens.

**1037.5.1** Test specimens shall be prepared by welding representative studs to the center of square specimen plates, 1/2 to 3/4 inch thick, in accordance with ASTM A 36. At the option of the manufacturer, several studs may be welded to a large plate and the specimen plates cut of a size suitable for test equipment used. Studs shall be welded with power source, welding gun and control equipment as recommended by the manufacturer. Welding voltage, current and time shall be measured by suitable instrumentation and recorded for each specimen. Lift and plunge shall be at the optimum setting as recommended by the manufacturer.

**1037.5.2** Studs shall be of uniform quality and condition, free from laps, fins, seams, cracks, twists, bends or other injurious defects. The finish shall be as produced by cold drawing, cold rolling or machining. The overall height after welding will be shown on the plans. The size of studs with allowable tolerance shall be as follows.

Stud Size - Inches				
Shank Diameter	Shank Diameter Tolerances	Overall Height (Tolerance After Welding)	Head Diameter	Head Thickness, Min.
3/4	+ 0.000 - 0.010	+ 0.062 - 0.125	1 1/4 ± 1/64	3/8
7/8	+ 0.000 - 0.010	+ 0.062 - 0.125	1 3/8 ± 1/64	3/8

**1037.5.3** Thirty test specimens shall be welded consecutively with optimum current and time. Optimum current and time shall be the midpoint of the range normally recommended by the manufacturer for production welding.

**1037.5.4** Thirty test specimens shall be welded consecutively with time held constant at optimum, but with current 10 percent below optimum.

**1037.5.5** Thirty test specimens shall be welded consecutively with time held constant at optimum, but with current 10 percent above optimum.

**1037.6 Qualification Tests.**

**1037.6.1 Tensile Tests.** Ten of the specimens welded in accordance with [Sec 1037.5.3](#), ten in accordance with [Sec 1037.5.4](#) and ten in accordance with [Sec 1037.5.5](#), shall be subjected to a tensile test. Tensile properties shall be determined in accordance with the applicable sections of AASHTO T 244. If a fracture occurs outside the middle half of the gage length, the test shall be repeated. A stud will be considered as qualified if all test specimens meet the following requirements:

Property	Requirement
Tensile Strength, min	60,000 psi
Yield Strength, as determined by a 0.2% offset method, min	50,000 psi
Elongation, min	20% in 2 inches
Reduction of Area, min	50%

**1037.6.2 Bend Tests.** Twenty of the specimens welded in accordance with [Sec 1037.5.3](#), 20 in accordance with [Sec 1037.5.4](#) and 20 in accordance with [Sec 1037.5.5](#), shall be bent alternately 30 degrees in opposite directions until failure occurs. A stud will be considered as qualified if, on all test specimens, fracture occurs in the shank of the stud and not in the weld.

**1037.7 Retests.** If a weld failure occurs in any of the tensile or bend test groups, another test group may be prepared and tested. If weld failure repeats, the stud shall fail to qualify.

**1037.8 Qualification.** For a manufacturer's studs and arc shields to be qualified, each group of thirty studs shall, by test or retest, meet the requirements specified in [Sec 1037.6](#).

**1037.9 Report of Tests.** The report of the testing laboratory to the manufacturer shall include the following:

- (a) Drawings which show shapes and dimensions with tolerances of studs, arc shields and flux.
- (b) A complete description of material used in the studs and arc shields, including the quantity and analysis of the flux.
- (c) A certification that the studs and arc shields described in the report are qualified in accordance with [Sec 1037.8](#).

**1037.10 Certification.** Prior to inspection, the contractor shall submit to the engineer the following information:

- (a) The name of the manufacturer.
- (b) A detailed description of the studs to be furnished.

(c) A certification from the manufacturer that the studs delivered are qualified in accordance with [Sec 1037.8](#).

(d) A copy of the qualification test results as certified by the testing laboratory unless the source and manufacturing process for these studs has been previously approved.

(e) Certified copies of in-plant quality control test results.