



Designation: ~~A769/A769M—05 (Reapproved 2010)~~ A769/A769M – 17

Standard Specification for Carbon and High-Strength Electric Resistance Forge- Welded Steel Structural Shapes¹

This standard is issued under the fixed designation A769/A769M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope—Scope*

1.1 This specification covers carbon and high-strength steel shapes of structural quality manufactured by the electric-resistance forge-welding process from coils.

1.2 The size range covered is described in nominal dimensions for columns, beams, and tees.

Web thickness	Size Range, in. (mm)
Web thickness	0.060 to 0.375 [1.5 to 10]
Flange thickness	0.060 to 0.500 [1.5 to 12.7]
Overall depth	0.060 to 0.500 [1.5 to 12.7]
Flange width	2.00 to 24.00 [50 to 600]
	0.50 to 12.00 [12.7 to 300]

1.3 These shapes are intended for two classes of application:

1.3.1 *Class 1*—General structural use where static loading predominates.

1.3.2 *Class 2*—Structural use where fatigue loading occurs and is a principal design consideration.

NOTE 1—~~Caution—Caution~~Because of the absence of smooth, integral, large radius fillets at the junctions of the webs and the flanges (see Fig. 1), fatigue limits of resistance forge-welded shapes in torsion, lateral loading, and flexure are usually lower than those for hot-rolled shapes of similar size and material. Users should consult shape manufacturers for recommended values of fatigue limits for each specific use, material, and size in cases where dynamic loading is a principal design consideration.

1.4 When the steel is to be welded, it is presupposed that a welding procedure suitable for the grade of steel and intended use or service will be utilized. See Appendix X3 of Specification A6/A6M for information on weldability.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.6 The following safety hazards caveat pertains only to the test methods portion, Section 10, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards*:²

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

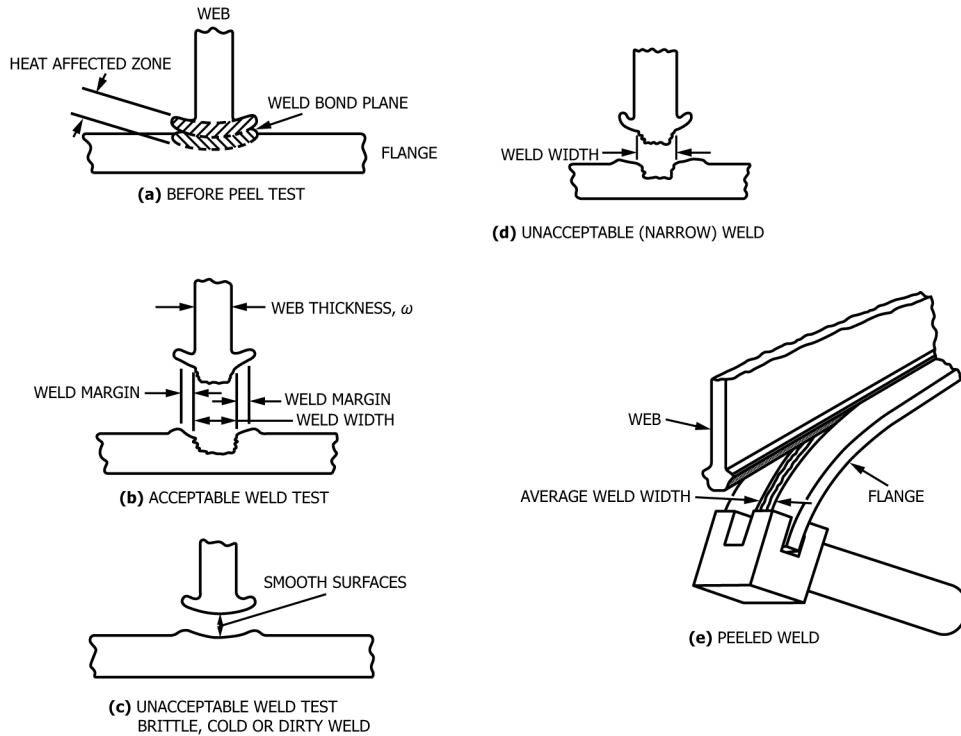


FIG. 1 Appearance of Peel Test Criteria

[A635/A635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment](#)
 2.2 American Welding Society Standard: [AWS Specification D 1.1 Structural Welding Code](#)³

3. Ordering Information

- 3.1 Orders for material under this specification should include the following, as required, to describe the desired material adequately:
- 3.1.1 Quantity (total number of feet (metres) or lengths),
 - 3.2 ASTM designation and year of issue, grade, and class,
 - 3.3 Shape and size,
 - 3.4 Length of each piece,
 - 3.5 Information on intended application,
 - 3.6 Other special requirements, and
 - 3.7 Required certification and test reports.

4. Materials and Manufacture

- 4.1 The shapes shall be manufactured from coils by the electric-resistance forge-welding process. All components of a shape shall be furnished to the same grade unless otherwise specified.
- 4.2 For Class 1 shapes the average width of weld at the joint to the flange shall be more than 110 % of the nominal web thickness (see Fig. 1(b)). The acceptability of coil-splice welds in webs and flanges shall be subject to negotiation between the purchaser and the manufacturer.
- 4.3 For Class 2 shapes the average width of weld at the joint to the flange shall be more than 130 % of the nominal web thickness (see Fig. 1(b)). Coil-splice welds shall not be permitted.
- 4.4 Flash caused by welding will not be removed unless indicated on the purchase order.

³ Available from American Welding Society (AWS), 550 NW LeJeune Rd., 8669 NW 36 St., #130, Miami, FL 33126-3316-6672, <http://www.aws.org>.



NOTE 2—Flash is considered to be non-structural.

5. Chemical Composition

5.1 A chemical analysis of each heat of steel shall be made by the steel manufacturer. The chemical composition thus determined shall conform to the requirements of Table 1, subject to the product analysis tolerances in Specification. The steel manufacturer shall provide a test report A6/A6M for plate steels or Specification of the heat analysis to the A568/A568M for sheet steels. Heat analysis reports shall be furnished by the shape manufacturer upon request to the shape purchaser.

5.2 The steel supplier, manufacturer, shape manufacturer, and the shape purchaser shall establish a chemical composition, which will assure the purchaser of the desired properties while providing the shape manufacturer with material that is weldable by the electric-resistance welding process.

6. Tension Test

6.1 The material as represented by the test specimen shall conform to the requirements of tensile properties prescribed in Table 2.

6.2 The shape manufacturer shall furnish, upon request, furnish test reports of tensile properties determined in accordance with Sections 8, 9, and 10.

7. Permissible Variations in Dimensions

7.1 Unless otherwise agreed upon by the shape manufacturer and the purchaser, dimensional variations shall conform to Specification A6/A6M (12.3 and Tables 16 to Tables 24 inclusive) for shapes of similar dimensions. Thicknesses of the shape components shall be based on nominal thicknesses conforming to Specification A6/A6M (Table 1, plate) or Specification A568/A568M (Tables 4 and Tables 5, sheet) for material thickness between 0.031 to 0.230 in. inclusive or Specification A635/A635M (Tables 2 and Tables 3) for material thickness between 0.230 to 1.000 in. inclusive. Nominal thickness shall be defined as the minimum thickness specified plus one half the allowable thickness tolerance as shown in the tables. The nominal weight per foot of the shape shall be calculated based on the nominal thickness and allowable variations in weight shall be equivalent to allowable variations in thickness.

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TABLE 1 Chemical Requirements^A

General Limitations, %	
Carbon	0.26 max
Manganese	0.30 min to 1.65 max
Phosphorus	0.04 max
Sulfur	0.03 max
Sulfur	0.05 max
Sulfur	0.035 max
Silicon	0.60 max

^A The choice and use of alloying elements (combined with carbon, manganese, phosphorus, and sulfur within the limits prescribed) to provide the specified mechanical properties, or to enhance the atmospheric corrosion resistance, or both, may vary with manufacturer and thickness of material. Elements commonly added include: boron, chromium, copper, molybdenum, nickel, silicon, vanadium, titanium, zirconium, and columbium. The heat analysis, including the alloying elements intentionally added, shall be reported to the purchaser. Permitted variations in product analysis shall be within the limits established in Table BA of Specification A6/A6M: for plate steel coils or Specification A568/A568M for sheet steel coils.



TABLE 2 Mechanical Properties

Grade	36	45	45W ^A	50	50W ^A	60	80
Tensile strength, min, psi [MPa]	53 000 [365]	60 000 [415]	65 000 [450]	65 000 [450]	70 000 [485]	75 000 [520]	90 000 [620]
Yield point, min, psi [MPa]	36 000 [250]	45 000 [310]	45 000 [310]	50 000 [345]	50 000 [345]	60 000 [415]	80 000 [550]
Elongation, min, %							
in 2 in. [50 mm]	22	19	19	17	17	17	17
in 8 in. [200 mm] ^B	15	14	14	12	12	12	12

^A The suffix “W” indicates steel grades having atmospheric corrosion resistance approximately two times that of carbon structural steel with copper.

^B See elongation requirement adjustments under the Tension Tests section of Specification A6/A6M. See specimen orientation in the Tension Tests section of Specification A6/A6M.

8. Number of Tests

8.1 Tension Tests:

8.1.1 For steel ordered from the steel manufacturer as coiled sheet or plate to minimum mechanical properties (ASTM or equivalent), the shape manufacturer may certify his steel product based on manufacturer’s the steel manufacturer’s test reports of mechanical properties. Two tension tests, taken longitudinally, shall be made by the steel manufacturer from each heat, unless the finished material from a heat is less than 50 ton [50 Mg], in which case one tension test will be sufficient. When material rolled from one heat differs 0.050 in. [1.2 mm] or more in thickness, one tension test shall be made from both the thickest and thinnest material rolled regardless of the weight represented.

8.1.1.1 In addition, the shape manufacturer shall make one tension test using a specimen which is representative of the approximate middle of the original coil length.

8.1.2 For heavy thickness coils ordered to minimum mechanical properties, make one tension test of the end lap either by the steel manufacturer as in 8.1.1 or by the shape manufacturer.

8.1.2.1 In addition, the shape manufacturer shall make one tension test using a specimen which is representative of the approximate middle of the original coil length. Make these tests on the product of two coils from each heat for each nominal thickness which differs by more than 0.050 in. [1.2 mm] from the thickness already tested for that heat.

8.1.2 For all steel not made to minimum mechanical properties, regardless of thickness, the shape manufacturer shall make the tests as in 8.1.2 for each coil. coil per the requirements of Specification A6/A6M, sections 11.4.2, 11.4.3, or 11.4.4 (Tables B and C shall be followed) as applicable. Specimens taken for testing from the middle of the original coil length shall, in addition, be taken from the approximate quarter point of the original coil width.

8.2 Peel Tests:

8.2.1 One peel test, 8-210.2, is required on both sides of each butt weld on the flanges and web. A short (2 to 5 ft) sample shall be cut from the section and a peel test shall be performed on both ends of the section, on both welds.

8.3 Tee Tension Tests—One tee tension test, 8-310.3, is required of each weld for each lot.

8.3.1 A lot consists of not more than 1 h of welding of material of unchanged dimensions and heat number. A new lot will be started in the event of a dimension change or start of a new heat of steel for any component of the shape.

9. Retests

9.1 If one tension test fails, run two more tension tests from an adjacent location of the same parent coil. Both retests shall conform to the requirements prescribed in this specification; otherwise, the product of all coils represented by those tests shall stand rejected.

9.2 If the results of the peel tests and tee tension tests representing any lot do not meet a requirement as specified in Section 10, make two retests, one on each side of and adjacent to the original test, from the same lot. Each retest shall meet the requirements specified, or the lot represented by the retests shall be rejected.

10. Test Methods

10.1 Tension Test:

10.1.1 The tension specimens required by this specification shall conform to those described in the latest issue of Test Methods A370.

10.1.2 Take all tension test specimens longitudinally. Remove all burrs from the specimens and ensure that there are no surface imperfections that would interfere with proper determination of the tensile properties of the metal.

10.1.3 Determine the mechanical properties, Table 2, in accordance with one of the methods described in Test Methods A370.

10.2 Peel Test—The peel test is conducted to determine weld width and ductility. In this test it is necessary to separate the flange from the web and the flange from the stem of tee sections mechanically for a length of approximately 2 in. (50 mm) by any method that places the weld bond plane in progressive, peeling tension. A slotted bending hook, Fig. 2(a), is preferred. Fracture may be initiated on the bond plane by a notch pressed or sawed into the end of the specimen along the weld bond plane (Fig. 2(c)). Striking