Designation: B361 – 16

Standard Specification for Factory-Made Wrought Aluminum and Aluminum-Alloy Welding Fittings[1]

This standard is issued under the fixed designation B361; 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*

1.1 This specification covers only factory-made wrought aluminum and aluminum-alloy welding fittings in contrast to field-made fittings. The term "welding fittings" applies to butt-welding or socket-end parts, such as 45° elbows, 180° return bends, 90° short radius elbows, and other types made to the dimensional standards specified by ASME B16.9 and B16.11.

NOTE 1—Throughout this specification use of the term *alloy* in the general sense includes aluminum as well as aluminum-alloy.

1.2 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see Annex A1.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 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 heal practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[2]

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B210 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

B211 Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire

B221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B234 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers

B241/B241M Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

B247 Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings

B660 Practices for Packaging/Packing of Aluminum and Magnesium Products

B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

D3951 Practice for Commercial Packaging

2.3 *ANSI Standards:*

H35.1/H35.1(M) Alloy and Temper Designation Systems for Aluminum[3]

2.4 *ASME Standards:*

B16.9 Factory-Made Wrought Butt-Welding Fittings[4]

B16.11 Forged Fittings, Socket-Welding and Threaded[4]

Section VIII Boiler and Pressure Vessel Code[4]

Section IX Boiler and Pressure Vessel Code[4]

2.5 *AWS Standards:*

AWS D10.7M/D10.7 Recommended Practices for Gas Shielded-Arc Welding of Aluminum and Aluminum-Alloy Pipe[5]

2.6 *Manufacturers' Standardization Society of the Valve and Fittings Industry:*

MSS SP 25 Standard Marking System for Valves, Fittings, Flanges and Unions[6]

[1] This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

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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.

[3] Available from Aluminum Association, Inc., 1400 Crystal Drive Suite 430, Arlington, VA 22202, http://www.aluminum.org.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

[5] Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.

[6] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

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

2.7 *Federal Standards:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[7]
2.8 *American Society for Nondestructive Testing Standard:*
ASNT Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing[8]

3. Terminology

3.1 *Definitions*—Definitions: Refer to ASTM Terminology B881 for definitions of product terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:
4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),
4.1.2 Size, shape, and dimensions (8.1),
4.1.3 Quantity in number of pieces,
4.1.4 Alloy (Section 5),
4.1.5 Temper (Section 5),
4.1.6 Class WP***S and WP***W (seamless or welded) shall be specified.

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:
4.2.1 Whether tension tests of finished fittings are required (9.1),
4.2.2 Whether hydrostatic tests are required (10.2),
4.2.3 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 11),
4.2.4 Whether Practices B660 applies and, if so, the levels of preservation, packaging, and packing required (14.3), and
4.2.5 Whether certification is required (Section 15).
4.2.6 For civil agencies, whether marking for shipment shall be in accordance with Fed. Std. No. 123 or ASTM Practice D3951.

5. Material

5.1 The aluminum or aluminum-alloy material used in the manufacture of the fittings shall be in accordance with the alloy and temper specified in the order. The material shall be in the form of rod, bar, forgings, sheet, plate, seamless pipe or seamless tube, each of which conforms to all requirements of the applicable ASTM specifications for the particular form and alloy involved. The applicable ASTM specifications and alloy designations are listed in Table 1.

6. Manufacture

6.1 Forging or shaping operations may be performed by hammering, pressing, piercing, rolling, extruding, upsetting, bending, fusion welding, machining, or by a combination of two or more of these operations. The forming procedure shall be so applied that it will not produce injurious defects in the fittings.

6.2 Fittings ordered as Class WP***S shall be of seamless construction and meet all requirements of ASME B16.9.

6.3 Fittings ordered as Class WP***W shall meet the requirements of ASME B16.9 and shall have full penetration fusion welds radiographically examined throughout their entire length in accordance with Paragraph UW-51 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. The radiography of this class of fittings may be done either prior to or after forming at the option of the manufacturer.
6.3.1 All welds shall be made in accordance with procedures by welders or welding operators qualified under the requirements of the ASME Boiler and Pressure Vessel Code, Section IX.
6.3.2 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

6.4 For welds made in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, the joint shall be reinforced at the center of the weld by at least 1⁄16 in. (1.6 mm) but not more than 1⁄8 in. (3.2 mm). Unless otherwise agreed upon between the producer and the purchaser, this reinforcement may be removed at the producer's option. The contour of the reinforcement shall be smooth, with no valley or groove along the edge or in the center of the weld, and the deposited metal shall be fused smoothly and uniformly into the surface of the original material. The finish of the welded joint shall be reasonably smooth and free of irregularities, grooves, or depressions.

7. Responsibility for Quality Assurance

7.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to assure that material conforms to prescribed requirements.

7.2 *Lot Definition*—An inspection lot shall consist of all fittings of the same alloy, size, shape, and dimensions subjected to inspection at one time.

8. General Quality

8.1 The sizes, shapes, and dimensions, and, unless otherwise specified, the end preparation (Note 2), shall be as specified for fittings covered by ASME B16.9 and B16.11.

NOTE 2—Other types of end preparations have been developed such as

[7] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.
[8] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

TABLE 1 Requirements for Aluminum and Aluminum-Alloy Materials Used in the Manufacture of Fittings

Alloy Designation[A,B]	Type of Material	Applicable ASTM Specifications			
		Pipe or Tube	Plate	Bar	Forging
WP1060[C]	99.6 % pure aluminum	B210 B221 B234 B241/B241M	 B209	 B211 B221	 ...
WP1100[C]	commercially pure low-strength aluminum	B210 B221 B241/B241M	 B209	 B211 B221	 B247
WP3003[C]	aluminum-base manganese alloy	B210 B221 B234 B241/B241M	 B209	 B211 B221	 B247
WP Alclad[C] 3003	aluminum-base manganese alloy core, clad on one side (inside only) in case of pipe	B210 B221 B234 B241/B241M	 B209	 	
WP5083[D]	aluminum-base magnesium-manganese alloy	B210 B221 B241/B241M	 B209	 B221	 B247
WP5086[D]	aluminum-base magnesium-manganese alloy	B210 B221 B241/B241M	 B209	 B221	
WP5154[C]	aluminum-base magnesium alloy	B210 B221	 B209	B211 B221	
WP6061	aluminum-base magnesium-silicon heat-treatable alloy	B210 B221 B234 B241/B241M	 B209	 B211 B221	 B247
WP6063	aluminum-base magnesium-silicon heat-treatable alloy	B210 B221 B241/B241M	 ...	 B221	 ...

[A] When fittings are of welded construction, designation shall be supplemented by the suffix "W."
[B] These alloy designations were established in accordance with ANS1 H35.1/H35.1(M), except for the letter symbols "WP," which denote wrought product.
[C] Fittings in nonheat-treatable alloys 1060, 1100, 3003, Alclad 3003, and 5154 are available only in the F or H112 tempers as covered by the applicable raw material specification.
[D] Fittings in nonheat-treatable alloys 5083 and 5086 are available in the O, F, or H112 tempers as covered by the applicable raw material specification.

the "V" groove of ASME B16.9 and B16.11, which appear to be superior to the straight bevel under many circumstances. They may be specified when desired. The so-called "modified vee" end preparation described in AWS D10.7 is one example.

8.2 Unless otherwise specified, the material shall be supplied in the mill finish and shall be uniform as defined by the requirements of this specification and shall be commercially sound. Any requirement not so covered is subject to negotiation between producer and purchaser.

9. Tension Tests

9.1 Tension tests of the finished fittings are not required, unless otherwise agreed upon between the producer and the purchaser and so specified in the order. When tension tests are made, methods of test, test specimens, and sampling frequency shall be agreed upon between the producer and the purchaser.

10. Hydrostatic Tests

10.1 Welding fittings shall be capable of withstanding an internal hydrostatic pressure, calculated according to the following equation, without developing leaks:

$$P = 2St/D \quad (1)$$

where:

P = maximum hydrostatic test pressure (gauge), psi (MPa) (Note 3),
S = 0.50 times the minimum specified yield strength of the designated material, psi (MPa),
t = nominal wall thickness, in. (mm) of designated schedule number (Note 4), and
D = outside diameter at bevel, in. (mm).

10.2 Hydrostatic acceptance tests shall be made only when agreed upon between the producer and the purchaser and so specified in the order.

NOTE 3—See Appendix X1.

NOTE 4—For nominal wall thicknesses corresponding to schedule numbers, see Specification B241/B241M.

11. Source Inspection

11.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the material prior to

shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

11.2 When such inspection or witness of inspection and testing is agreed upon, the seller shall afford the purchaser's representative all reasonable facilities to satisfy him that the material meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

12. Retest and Rejection

12.1 If any material fails to conform to all of the applicable requirements of this specification, it shall be cause for rejection of the inspection lot.

12.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling plan is provided or approved by the purchaser through the contract or purchase order, at least two additional specimens shall be selected to replace each test specimen that failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

12.3 Material in which defects are discovered subsequent to inspection may be rejected.

12.4 If material is rejected by the purchaser, the producer or supplier is responsible only for replacement of material to the purchaser. As much as possible of the rejected material shall be returned to the producer or supplier.

13. Identification Marking of Product

13.1 The producer's name or trademark, the size and schedule number, and the material shall be stamped (Note 5), stenciled, or otherwise suitably marked on each fitting. When the size does not permit complete marking, identification marks may be omitted in the sequence specified in SP25, of the Manufacturers' Standardization Society of the Valve and Fittings Industry. Each fitting shall be marked with the alloy designation listed in Table 1. On wall thicknesses thinner than Schedule 40, no stamps or other indented marking shall be used.

NOTE 5—If steel stamps are used, care should be taken so that the marking is not deep enough to cause cracks or to reduce the wall thickness of the fittings below the minimum allowed.

14. Packaging and Package Marking

14.1 The material shall be packaged to provide adequate protection during normal handling and transportation, and each package shall contain only one size, alloy, and temper of material unless otherwise agreed. The type of packaging and gross mass of containers shall, unless otherwise agreed, be at the producer's or supplier's discretion, provided that they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

14.2 Each shipping container shall be marked with the purchase order number, material size, specification number, alloy and temper, gross and net masses, and the producer's name or trademark.

14.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B660. The applicable levels shall be as specified in the contract or order.

14.4 For civil agencies, marking for shipment shall be in accordance with Fed. Std. No. 123 or ASTM Practice D3951, depending on which is specified on the contract or purchase order.

15. Certification

15.1 The producer or supplier shall, on request, furnish to the purchaser a certificate stating that each lot has been sampled, tested, and inspected in accordance with this specification, and has met the requirements.

16. Keywords

16.1 aluminum alloy; welding fittings

ANNEX

(Mandatory Information)

A1. ACCEPTANCE CRITERIA FOR INCLUSION OF NEW ALUMINUM AND ALUMINUM ALLOYS IN THIS SPECIFICATION

A1.1 Prior to acceptance for inclusion in this specification, the composition of wrought or cast aluminum or aluminum alloy shall be registered in accordance with ANSI H35.1/H35.1(M). The Aluminum Association[3] holds the Secretariat of ANSI H35 Committee and administers the criteria and procedures for registration.

A1.2 If it is documented that the Aluminum Association could not or would not register a given composition, an alternative procedure and the criteria for acceptance shall be as follows:

A1.2.1 The designation submitted for inclusion does not utilize the same designation system as described in ANSI H35.1/H35.1(M). A designation not in conflict with other designation systems or a trade name is acceptable.

A1.2.2 The aluminum or aluminum alloy has been offered for sale in commercial quantities within the prior twelve months to at least three identifiable users.

A1.2.3 The complete chemical composition limits are submitted.

A1.2.4 The composition is, in the judgment of the responsible subcommittee, significantly different from that of any other aluminum or aluminum alloy already in the specification.

A1.2.5 For codification purposes, an alloying element is any element intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified. Unalloyed aluminum contains a minimum of 99.00 % aluminum.

A1.2.6 Standard limits for alloying elements and impurities are expressed to the following decimal places:

Less than 0.001 %	0.000X
0.001 to but less than 0.01 %	0.00X
0.01 to but less than 0.10 %	
Unalloyed aluminum made by a refining process	0.0XX
Alloys and unalloyed aluminum not made by a refining process	0.0X
0.10 through 0.55 %	0.XX
(It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5.)	
Over 0.55 %	0.X, X.X, etc.
(except that combined Si + Fe limits for 99.00 % minimum aluminum must be expressed as 0.XX or 1.XX)	

A1.2.7 Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc; Titanium (Note A1.1); Other Elements, Each; Other Elements, Total; Aluminum (Note A1.2).

NOTE A1.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between Titanium and Other Elements, Each, or are specified in footnotes.

NOTE A1.2—Aluminum is specified as *minimum* for unalloyed aluminum and as a *remainder* for aluminum alloys.

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of 1 kg gives it an acceleration of 1 m/s^2 ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference of Weights and Measures. Since 1 ksi = 6 894 757 Pa the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B361 – 08) that may impact the use of this standard. (Approved May 1, 2016.)

(1) Revised A1.2.7 and Note A1.1.