Designation: A1069/A1069M – 19

Standard Specification for Laser and Laser Hybrid Welded Stainless Steel Bars, Plates, and Shapes[1]

This standard is issued under the fixed designation A1069/A1069M; 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 laser and laser hybrid welded austenitic, ferritic, and duplex (ferritic-austenitic) stainless steel bars, plates, and shapes of structural quality for use in bolted or welded structural applications.

NOTE 1—The term laser fusion is also used to describe laser welding.

1.1.1 Supplementary requirements (S1, S2, S3) of an optional nature are provided. They shall apply only when specified by the purchaser.

1.2 Shapes covered in this specification include those classified in Article 3.1.2 of Specification A6/A6M, Specification A554 square and rectangular hollow sections, and additional shapes, including customized, that are made from two or more shapes or plates.

1.3 This specification establishes the minimum requirements for manufacturing of laser and laser hybrid welded stainless steel shapes.

1.4 This specification refers to Specifications A240/A240M, A276/A276M, A554, or A479/A479M for chemical requirements, but the mechanical test requirements are determined by the mechanical properties section of this standard.

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 *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, health, and environmental 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

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A276/A276M Specification for Stainless Steel Bars and Shapes

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A380/A380M Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

A479/A479M Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

A554 Specification for Welded Stainless Steel Mechanical Tubing

A673/A673M Specification for Sampling Procedure for Impact Testing of Structural Steel

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A751 Test Methods and Practices for Chemical Analysis of Steel Products

A923 Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.17 on Flat-Rolled and Wrought Stainless Steel.

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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**

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
A1084 Test Method for Detecting Detrimental Phases in Lean Duplex Austenitic/Ferritic Stainless Steels
E190 Test Method for Guided Bend Test for Ductility of Welds
E208 Test Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels
E290 Test Methods for Bend Testing of Material for Ductility
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 *ISO Standards:*
ISO 13919-1 Welding and Laser-beam Welded Joints-guidance on Quality Levels for Imperfections—Part 1: Steel
ISO 12932 Welding – Laser-arc hybrid welding of steels, nickel and nickel alloys – Quality levels for imperfections
ISO 4063 Welding and allied processes - Nomenclature of processes and reference numbers
ISO 15609-4 Specification and Qualification of Welding Procedures for Metallic Materials—Welding Procedure Specification
ISO 15609-6 Specification and qualification of welding procedures for metallic materials -- Welding procedure specification -- Part 6: Laser-arc hybrid welding
ISO 15614-11 Specification and Qualification of Welding Procedures for Metallic Materials—Welding Procedure Test—Part 11: Electron and Laser Beam Welding

2.3 *U.S. Military Standards:*
MIL-STD-129 Marking for Shipment and Storage

2.4 *Federal Standards:*
Federal Standard No. 123 Marking for Shipment (Civil Agencies)

2.5 *AWS Standards:*
AWS A3.0M/A3.0 Standard Welding Terms and Definition, Including Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying
AWS D1.6/D1.6M Structural Welding Code – Stainless Steel
AWS C7.2M Recommended Practices for Laser Beam Welding, Cutting, and Allied Processes
AWS C7.4/C7.4M Process Specification and Operator Qualification for Laser Beam Welding
AWS C7.6/C7.6M Process Specification and Operator Qualification for Laser Hybrid Welding

2.6 *ASME Standards:*
ASME SA-370
ASME BPVC.IX-2019 ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications

2.7 *SAE Standard:*
J1086 Practice for Numbering Metals and Alloys (UNS)

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of general terms pertaining to this specification shall be those of Terminology A941, "Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys."

3.1.2 Definitions of terms pertaining to welding terminology shall be those of AWS A3.0M /A3.0, "Standard Welding Terms and Definition, Including Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying."

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material ordered to this specification. Such requirements shall include but are not limited to the following:

4.1.1 Name of structural product.

4.1.2 Shape designation and applicable dimensions including size, thickness, width, diameter, and length, if applicable.

4.1.3 UNS designation.

NOTE 2—Stainless steel alloys are identified in the ASTM standards by Unified Numbering System (UNS) number in accordance with Practice E527 and SAE J1086.

4.1.4 Quantity (weight or number of pieces).

4.1.5 ASTM specification designation and edition year if other than the latest edition.

4.1.6 Condition of welded product, whether as welded, or subsequently stress-relieved, or heat treated.

4.1.7 Finish in accordance with Section 9.

4.2 The purchaser has the option to specify additional requirements, including but not limited to the following:

4.2.1 Supplementary Requirements, if invoked.

4.2.1.1 S1. Charpy V-notch Impact Test for Structural Shapes.

4.2.1.2 S2. Drop-weight Test (for Material 0.625 in. [16 mm] and Over in Thickness).

4.2.1.3 S3. Intergranular Corrosion Test.

4.2.2 Preparation for special delivery.

4.2.3 Special marking requirements.

4.2.4 Other special requirements.

NOTE 3—A typical ordering description is as follows: 5000 lb (2300 kg), Angle, L4 × 4 × ½ in. (L100 × 100 × 13 mm), laser or laser hybrid welded, 20 ft (6 m) in length, Type 304L, ASTM Specification AXXXX dated ____.

5. Materials and Manufacture

5.1 *Condition:*

5.1.1 The stainless steel purchased to produce A1069/A1069M shapes shall be in accordance with the requirements of the following specifications.

5.1.1.1 *Mechanical Properties:*

(1) If strength Grade 1 is specified, then the mechanical properties shall be in accordance with the appropriate specification, either Specification A240/A240M, A276/A276M, or Specification A479/A479M.

(2) If austenitic stainless steel strength Grade 2 is specified then the purchased material shall meet the minimum mechanical property requirements in Table 1.

TABLE 1 Mechanical Test Requirements[A,B,C,G]

Strength Grade	Tensile Strength, min		Yield Strength, min		Elongation in 2 in. or 50 mm, min, %
	ksi	MPa	ksi	MPa	
Austenitic (Chromium-Nickel) (Chromium-Manganese-Nickel)					
2[D]	80	550	35	240	35
Duplex (Austenitic-Ferritic)					
3[E]	95	655	65	450	25
4[F]	116	795	80	550	15

[A] Yield strength shall be determined by the offset method at 0.2 % in accordance with Test Methods and Definitions A370. Unless otherwise specified.
[B] Bend tests are not required for any austenitic or duplex (austenitic-ferritic) stainless steels regardless of thickness.
[C] Brinell or Rockwell Hardness hardness requirements are determined by Specifications A240/A240M, A276/A276M, A554 or A479/A479M.
[D] This strength level applies to the following austenitics (UNS number (common name): UNS S30403 (304L), S30409 (304H), S31603 (316L), S31653 (316LN), and S31703 (317L). Order all other austenitics to strength Grade 1, ASTM A240/A240M mechanical properties.
[E] This strength level applies to S32205 (2205) up to 2.5 in. (64 mm) in thickness.
[F] This strength level can be achieved by the more highly alloyed, more corrosion resistant and higher strength super duplexes like S32750, and S32760 is limited to thicknesses of up to 2 inches (50 mm).
[G] All ferritic and duplex (austenitic-ferritic) stainless steels not listed in this table shall be ordered to strength grade 1 in accordance with 7.1.1.

(3) If UNS S32205 (2205) duplex stainless steel strength Grade 3 is specified then the purchased material shall meet those minimum mechanical property requirements in Table 1.

(4) If super duplex strength Grade 4 is specified, as defined in the footnote F of Table 1, then the purchased material shall meet the minimum mechanical property requirements in Table 1.

5.1.1.2 *General and Chemical Requirements:*

(1) Plate, sheet, and strip shall conform to the requirements of Specification A480/A480M and the chemical requirements of Specification A240/A240M.

(2) Bars and shapes shall conform to the requirements of Specification A484/A484M and the chemical requirements of Specification A276/A276M.

(3) Bars and shapes for use in boilers and other pressure vessels shall conform to the requirements of Specification A484/A484M and the chemical requirements of Specification A479/A479M.

5.1.2 Shape products shall be in the as-welded condition unless otherwise specified or necessary to meet the requirements of this specification.

5.1.3 Laser or laser hybrid weld process shall comply with either:

5.1.3.1 ISO 15614-11 and ISO 15609-4 or ISO 15609-6.

5.1.3.2 AWS D1.6/D1.6M Clause 6 and AWS C7.4/C7.4M, or AWS C7.6/C7.6M.

(1) When complying with AWS requirements, the practices of AWS C7.2M shall be used.

5.1.4 The quality levels of welded joints shall be in accordance with either:

5.1.4.1 ISO 13919-1 or ISO 12932 standard. If not otherwise specified, quality level B of ISO 13919-1 or ISO 12932 standard shall be met.

5.1.4.2 AWS C7.4/C7.4M class A, unless otherwise specified, or AWS C7.6/C7.6M.

5.1.5 The tensile strength of the weldment conducted on test specimens excised from the laser or laser hybrid welded stainless steel plates, sheet, or strip, as shown in Fig. 1, shall meet or exceed the requirements of Specifications A240/A240M, A276/A276M, or A479/A479M or Table 1 of this specification, dependent on the Grade level specified in the purchase order. Tensile testing and specimen dimensions shall be in accordance with Test Methods A370 or ASME SA370, if specified.

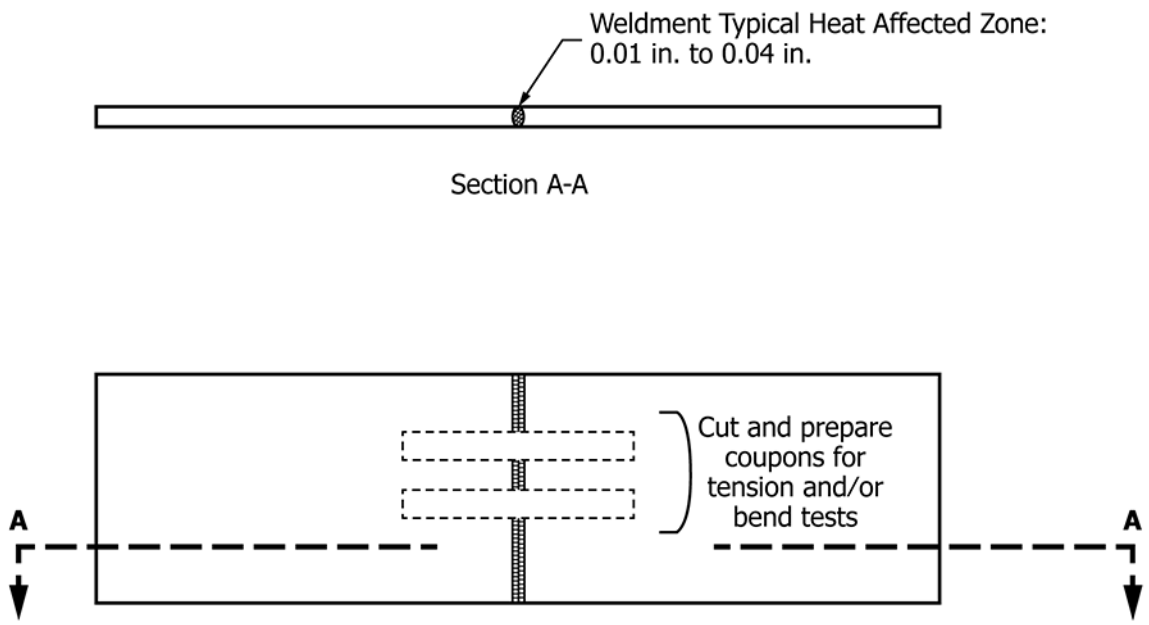

FIG. 1 Butt-welded Test Pieces Are Laser or Laser-Hybrid Welded and Then Subsequently Machined Into Tensile Test Bars and Root-bend Test Specimens (Not to Scale)