Designation: A 711/A 711M – 07

Standard Specification for Steel Forging Stock[1]

This standard is issued under the fixed designation A 711/A 711M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers cast carbon and alloy steel ingots and strand castings, semi-wrought ingots and strand castings and rolled or forged blooms, billets, and slabs for forging.

1.2 Blooms, billets, and slabs are semi-finished steel products, hot rolled or forged to approximate cross-sectional dimensions. Blooms and billets may be square, round, octagonal, or rectangular in section; slabs are rectangular. Although no invariable rule prevails between the terms blooms and billets, and they are frequently used interchangeably, the following size distinctions are in general use.

1.2.1 *Blooms*—Cross-sectional area greater than 36 in.^{2} [230 cm^2].

1.2.2 *Billets*—Maximum cross-sectional area 36 in.^{2} [230 cm^2].

1.2.3 *Slabs*—Minimum thickness, 1½ in. [4 cm]; width, more than twice the thickness; and generally a cross-sectional area of not less than 16 in.^{2} [100 cm^2].

1.2.4 Ingots either top or bottom poured or secondary remelted are covered.

1.2.5 Strand castings with or without additional reduction are covered.

1.3 Supplementary requirements (S1 to S19) of an optional nature are provided. They shall apply only when specified by the purchaser.

1.4 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.

1.5 Unless the order specifies the "M" specification, the material shall be furnished to the inch-pound units.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

A 275/A 275M Test Method for Magnetic Particle Examination of Steel Forgings

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings

A 788/A 788M Specification for Steel Forgings, General Requirements

E 45 Test Methods for Determining the Inclusion Content of Steel

E 112 Test Methods for Determining Average Grain Size

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

3. Ordering Information and General Requirements

3.1 When this specification is to be applied to an inquiry, contract, or order, the purchaser shall furnish the following information in addition to those specified in Specification A 788/A 788M:

3.1.1 The grade of material desired.

3.1.2 Product form restrictions (for example, ingots, strand castings, billets) if any, and

3.1.3 Applicable supplementary requirements.

3.1.4 Surface condition.

3.2 Material supplied to this specification shall conform to the requirements of Specification A 788/A 788M, which outlines additional ordering information, manufacturing requirements, testing and retsting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements.

3.2.1 If the requirements of this specification are in conflict with the requirements of Specification A 788/A 788M, the requirements of this specification shall prevail.

[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 A01.06 on Steel Forgings and Billets.

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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.**

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4. Materials and Manufacture

4.1 *Discard*—Sufficient discard shall be made to secure freedom from piping and undue segregation.

4.2 *Reduction from Ingot*—Except as otherwise agreed in accordance with Supplementary Requirement S3.2, the material shall be made from product having at least two times the cross-sectional area of the material.

4.3 *Stability*—Material shall be furnished in a condition to withstand, for an indefinite time, exposure to all climatic conditions without developing any external or internal cracks. The method of cooling or of treatment before shipment shall be optional with the manufacturer, but he shall be responsible (in the same manner as for defects disclosed after delivery) for cracks that may develop before material is subjected to reheating. When specific stability treatment of material is specified by the purchaser, the manufacturer shall be responsible only for carrying out those specific operations but shall not be responsible for cracks that may develop before material is subjected to reheating.

5. Chemical Composition

5.1 The chemical composition shall conform to the requirements specified in the purchase order or the individual product specification. For convenience the grades commonly specified for carbon and alloy steel, blooms, billets, or slabs are shown in Table 1 and Table 2 of the latest issue of Specification A 29/A 29M. Blooms, billets, or slabs may be ordered to these grade designations, and when so ordered shall conform to the specified limits by heat analysis.

5.2 *Heat Analysis*:

5.2.1 An analysis of each heat of steel shall be made in accordance with Specification A 788/A 788M.

5.3 *Product Analysis*:

5.3.1 A product analysis may be made by the purchaser in accordance with Specification A 788/A 788M.

5.3.2 To indicate adequately the composition of a heat or lot, samples selected to represent the heat as fairly as possible shall be taken midway between center and outside of the material from a minimum number of pieces as follows:

Lots	Number of Pieces
15 tons [13.5 t] or less	4
Over 15 tons [13.5 t]	6

5.3.3 If the number of pieces from cast or heat is less than the number of samples specified in 5.3.2, one sample shall be taken from each piece.

5.3.4 When chips are taken by drilling, the approximate diameter of the drill used shall be as follows:

Area of Cross Section to Be Sampled, in.^{2} [cm^2]	Approximate Drill Diameter, in. [mm]
16 [100] and under	½ [13]
Over 16 [100]	1 [25]

6. Permissible Variations

6.1 The permissible variation from the specified or theoretical weight of blooms, billets, and slabs shall be ±5 % for individual pieces or for lots of less than a carload. For carload lots the permissible variation shall be ±2.5 % of the total weight of the lot.

7. Workmanship, Finish, and Appearance

7.1 The material shall be free of injurious imperfections.

7.2 Conditioning, cutting, or parting of material may be done by scarfing or flame-cutting when methods involving preheating and temperature control necessary to avoid any damage to flame-cut material are employed.

7.3 *Surface Conditioning*—Material may be conditioned to remove injurious surface defects, provided the depth of conditioning does not exceed 1/16 in. [1.5 mm] for each inch of dimension concerned, up to a maximum depth of ¾ in. [20 mm], and provided that the width of the conditioning is at least four times its greatest depth; except that in the case of slabs where the width is at least twice the thickness, the depth of conditioning on the wide surfaces may exceed this allowance by 50 %, up to a maximum depth of ¾ in. [20 mm]. The maximum depth of conditioning on two parallel sides at opposite locations shall not exceed one and one half times the maximum allowed for one side. All conditioned areas must be flared to result in a uniform blending.

8. Keywords

8.1 billets; blooms; slabs; steel forging stock

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SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply when specified by the purchaser in the inquiry, contract, and order. Details of these supplementary requirements shall be agreed upon by the manufacturer and purchaser.

S1. Specified Process

S1.1 The steel shall be vacuum treated.

S2. Discard

S2.1 Specific discard shall be taken as defined in the ordering information.

S3. Reduction in Area

S3.1 The purchaser may specify any definite amount of reduction in area greater than 2.1 as provided in 4.2.

S4. Residual Elements

S4.1 Supplementary Requirement S1 of Specification A 788/A 788M shall apply.

S5. Restricted Product Analysis

S5.1 When product analysis to Specification A 788/A 788M is applicable, a more restrictive requirement for one or more chosen elements shall be stated in the ordering information.

S6. Guaranteed Segregation Tests

S6.1 In the ordering information the purchaser or his representative shall note the intention to make product analysis to represent each cast or heat. Two sets of drillings shall be taken from the top face of this piece at points on the same diagonal of the piece. The drillings shall be taken with a ⅝-in. [16-mm] drill parallel to the axis of the product as cast. The distance from the center of the piece to the drilling points shall be, respectively 15 and 80 % of the length of the half diagonal of the piece.

S6.2 From the drillings taken at the 80 % point, a complete analysis may be made. The chemical composition thus determined shall conform to the requirements specified.

S6.3 From the drillings taken at the 15 % point, a carbon determination may be made. The difference between the carbon content of the drillings from the 15 % point and that of the drillings from the 80 % point, expressed as a percentage of the latter, shall not exceed the following values:

Thickness, in. [mm]	Carbon Content Difference, %
15 [380] and under	15
Over 15 [380]	20

S6.4 If, in any heat, the drillings taken in accordance with S6.1 do not conform to the requirement prescribed in S6.3, additional drillings may be taken in a similar manner after making a further top discard from the material of at least 10 % of the original weight. The results of this analysis shall conform to the requirements prescribed in S6.3; otherwise, the heat represented shall be rejected.

S7. Guaranteed Heat Treatment

S7.1 The heat treatment requirements involve the size of material to be tested; location of test bar; the size, shape and method of preparing test specimens; temperature and time of treatment; agitation of quenching medium; and similar requirements. The minimum and maximum limits of a specified hardness range shall be consistent with the hardness obtainable in the full range of the specified chemical limits.

S8. Nonmetallic Inclusion Requirement

S8.1 The samples for testing shall be taken on a longitudinal place midway between the center and surface of the material. The samples shall be hardened before being polished to avoid polishing pits; the area to be examined shall be agreed upon between the manufacturer and the purchaser. The rating of the inclusion count shall be based upon the average length of the inclusions, the longest inclusion, and the general background. Any standards agreed upon shall be based upon a magnification of 100×. Reference may be made to Test Methods E 45.

S9. Macroetch Tests

S9.1 The location and number of the macroetch test specimens as well as acceptance criteria shall be as stated in the ordering information. The procedure used shall be in accordance with Method E 381 unless otherwise agreed upon.

S10. Magnetic Particle Examination

S10.1 Magnetic particle examination shall be performed in accordance with Test Method A 275/A 275M. The magnetizing procedure and acceptance limits shall be as stated in the ordering information.

S11. Ultrasonic Examination

S11.1 Unless otherwise agreed upon, the ultrasonic examination shall be based on Practice A 388/A 388M. The scanning procedure and acceptance criteria shall be as stated in the ordering information.

S12. Grain Size

S12.1 Except as qualified in S12.2, carburized austenitic grain size shall be specified as coarse or fine, to be determined in accordance with Test Methods E 112. The steel shall be designated as coarse grain when the grain structure falls within the limits depicted in photograph numbers 1 to 5, inclusive, of Plate IV of Test Methods E 112 and fine grain when the grain structure falls within photograph numbers 5 to 8, inclusive. The grain structure shall be considered satisfactory if 70 % is within the specified grain size limits. If these ranges are too broad for the purchaser's requirements, more restricted grain size limits may be agreed upon between the purchaser and the manufacturer.

S12.2 Due to certain manufacturing conditions, the grain size distinctions prescribed in S12.1 may not be adhered to in blooms larger than 100 in.^{2} [645 cm^2] in cross-sectional area nor in slabs larger than 20 by 5 in. [50 by 13 cm]. For these

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larger sizes, grain size requirements shall be negotiated between the purchaser and manufacturer.

S12.3 When aluminum is used as a grain refining element, the fine grain size requirement shall be deemed to be fulfilled if, on heat analysis, the aluminum content is not less than 0.015 % acid soluble aluminum, or alternately, 0.020 % total aluminum. The aluminum content shall be reported. The grain size test specified in S12.1 shall contiune to be the referee test.

S13. Fracture Tests

S13.1 A transverse fracture test to indicate soundness and homogeneity shall be made in accordance with the test method and acceptance criteria stated in the ordering information. A central area equivalent to at least 10 % of the total cross sectional area of the end of the piece shall be fractured.

S14. Surface Preparation

S14.1 For purposes of making possible closer inspection, the material shall be pickled in acid, or sand, or shot-blasted, or prepared by any other method agreed upon.

S15. Controlled Cooling and Treatment

S15.1 When more control than is provided in 4.3 is required, any or all of the following requirements, as described in the ordering information shall be done.

S15.1.1 A maximum controlled rate of cooling after hot working,

S15.1.2 Annealing, normalizing, or normalizing and tempering.

S15.1.3 A maximum hardness, or

S15.1.4 Suitability for cold shearing.

S16. Surface Conditioning

S16.1 A more limited removal depth for surface imperfections than that stated in 7.3 shall apply, as stated in the ordering information.

S16.1.1 Material removal shall be by scarfing, grinding, or chipping as stated in the ordering information.

S17. Marking and Identification

S17.1 Marking of the product, in addition to that required by Section 10, shall be as stated in the ordering information.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 711 – 04) that may impact the use of this standard. (Approved March 1, 2007.)

(*1*) Converted to dual designation.

(*2*) Revised metric units in 1.2, 5.3, 7.3, S6, and S12.

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