Designation: A 148/A 148M – 08

Standard Specification for Steel Castings, High Strength, for Structural Purposes[1]

This standard is issued under the fixed designation A 148/A 148M; 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 carbon steel, alloy steel, and martensitic stainless steel castings that are to be subjected to higher mechanical stresses than those covered in Specification A 27/A 27M.

1.2 Several grades of steel castings are covered, having the chemical composition and mechanical properties prescribed in Tables 1 and 2.

1.3 The values stated in inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 27/A 27M Specification for Steel Castings, Carbon, for General Application

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 781/A 781M Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. General Conditions for Delivery

3.1 Material furnished to this specification shall conform to the requirements of Specification A 781/A 781M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 781/A 781M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 781/A 781M, this specification shall prevail.

TABLE 1 Chemical Requirements

Grade (UNS No.)	Composition, %	
	Sulfur, max	Phosphorus, max
80-40 [550-275] (D50400)	0.06	0.05
80-50 [550-345] (D50500)	0.06	0.05
90-60 [620-415] (D50600)	0.06	0.05
105-85 [725-585] (D50850)	0.06	0.05
115-95 [795-655] (D50950)	0.06	0.05
130-115 [895-795] (D51150)	0.06	0.05
135-125 [930-860] (D51250)	0.06	0.05
150-135 [1035-930] (D51350)	0.06	0.05
160-145 [1105-1000] (D51450)	0.06	0.05
165-150 [1140-1035] (D51500)	0.020	0.020
165-150L [1140-1035L] (D51501)	0.020	0.020
210-180 [1450-1240] (D51800)	0.020	0.020
210-180L [1450-1240L] (D51801)	0.020	0.020
260-210 [1795-1450] (D52100)	0.020	0.020
260-210L [1795-1450L] (D52101)	0.020	0.020

4. Ordering Information

4.1 The inquiry and order should include or indicate the following:

4.1.1 A description of the casting by pattern number or drawing (dimensional tolerances shall be included on the casting drawing),

4.1.2 Grade of steel,

4.1.3 Options in the specification, and

4.1.4 The supplementary requirements desired, including the standards of acceptance.

5. Heat Treatment

5.1 All castings shall be heat treated either by full annealing, normalizing, normalizing and tempering, or quenching and tempering. Unless otherwise specified in the inquiry, contract, or order, the castings may be heat treated by any of these heat treatments or combination of these heat treatments at the option of the manufacturer.

5.2 Heat treatment shall be performed after the castings have been allowed to cool below the transformation range.

[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 A01.18 on Castings.

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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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TABLE 2 Tensile Requirements

Grade	Tensile strength min, ksi [MPa]	Yield point min, ksi [MPa]	Elongation in 2 in. or 50 mm, min, %[A]	Reduction of Area, min, %
80-40 [550-275]	80 [550]	40 [275]	18	30
80-50 [550-345]	80 [550]	50 [345]	22	35
90-60 [620-415]	90 [620]	60 [415]	20	40
105-85 [725-585]	105 [725]	85 [585]	17	35
115-95 [795-655]	115 [795]	95 [655]	14	30
130-115 [895-795]	130 [895]	115 [795]	11	25
135-125 [930-860]	135 [930]	125 [860]	9	22
150-135 [1035-930]	150 [1035]	135 [930]	7	18
160-145 [1105-1000]	160 [1105]	145 [1000]	6	12
165-150 [1140-1035]	165 [1140]	150 [1035]	5	20
165-150L [1140-1035L][B]	165 [1140]	150 [1035]	5	20
210-180 [1450-1240]	210 [1450]	180 [1240]	4	15
210-180L [1450-1240L][B]	210 [1450]	180 [1240]	4	15
260-210 [1795-1450]	260 [1795]	210 [1450]	3	6
260-210L [1795-1450L][B]	260 [1795]	210 [1450]	3	6

[A] When ICI test bars are used in tensile testing as provided for in this specification, the gage length to reduced section diameter ratio shall be 4 to 1.
[B] These grades must be charpy impact tested as prescribed in Section 9, and with minimum values as shown in Table 3.

6. Temperature Control

6.1 Furnace temperatures for heat-treating shall be regulated by the use of pyrometers.

7. Chemical Composition

7.1 The steel shall conform to sulfur and phosphorus requirements as prescribed in Table 1.

7.2 The content of carbon, manganese, silicon, and alloying elements may, by agreement, be prescribed by the purchaser. If not specified, the content may be selected by the manufacturer to obtain the required mechanical properties.

7.3 When the analysis of carbon, manganese, silicon, or any intentionally added alloying element is specifically requested in the contract or order, it shall be made by the manufacturer and reported to the purchaser. The results of these analyses shall not be used as a basis for rejection except by prior agreement.

8. Tensile Requirements

8.1 One tension test shall be made from each heat and shall conform to the tensile requirements specified in Table 2.

8.2 The test coupons and specimens shall conform to requirements specified in Section 11.

8.3 Tension test coupons shall be machined to the form and dimension shown in Fig. 4 of Test Methods and Definitions A 370 and tested in accordance with those test methods with the ends machined to fit the grips on the tensile testing machine to be used. Suggested types of ends for standard round tension test specimens are shown in Fig. 5 of Test Methods and Definitions A 370.

8.4 To determine conformance with the tension test requirements, an observed value or calculated value shall be rounded off in accordance with Practice E 29 to the nearest 500 psi [5 MPa] for yield point and tensile strength and to the nearest 1 % for elongation and reduction of area.

9. Charpy Impact Requirements

9.1 This section is applicable only to grades 165-150L [1140-1035L], 210-180L [1450-1240L], and 260-210L [1795-1450L].

NOTE 1—Other grades may be ordered to charpy impact test requirements in accordance with Supplementary Requirement S9 of Specification A 781/A 781M.

9.2 The notched bar impact properties of each heat shall be determined by testing one set of three Charpy V-notch impact specimens at –40° ± 2°F [–40° ± 1°C]. The energy value of the three specimens shall not be less than shown in Table 3.

9.3 Test coupons and specimens shall conform to the requirements specified in Section 11.

9.4 Impact test specimens shall be machined to the form and dimensions shown in Test Methods and Definitions A 370, Type A, Charpy V-notch specimen, Fig. 11, and tested in accordance with those test methods.

10. Retests

10.1 If the results of the tensile or charpy tests do not conform to the requirements specified, heat-treated castings may, at the manufacturer's option, be reheat treated. Testing after reheat treatment shall consist of the full number of specimens complying with the specification or order.

11. Test Coupons and Specimens

11.1 Test bars shall be poured from the same heat as the castings represented. Test coupons may be cast integrally with the castings or as separate blocks similar to those shown in Fig. 1 of Specification A 781/A 781M.

11.1.1 In the case of quenched and tempered castings where the ruling section of the casting exceeds three inches, supplementary requirement S15 of Specification A 781/A 781M shall apply.

TABLE 3 Impact Requirements

Grade	165-150L [1140-1035L]	210-180L [1450-1240L]	260-210L [1795-1450L]
Impact Requirements Charpy V-notch			
Energy value, ft·lbf [J], min value for two specimens and minimum average of three specimens	20 [27]	15 [20]	6 [8]
Energy value, ft·lbf [J], min for single specimen	16 [22]	12 [16]	4 [5]

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11.2 The bar from which the test piece is taken shall be heat treated in production furnaces with the castings or to the same procedure as the castings it represents.

11.2.1 When the bar from which the test piece is taken is not heat treated as part of the same heat treatment load as the casting(s) it qualifies, the austenitizing (or solution, if applicable) temperatures for the bar shall be within 25°F of those for the casting(s). The tempering temperature for the bar shall be no higher than 25°F above that of the casting(s) and no higher than permitted by the heat treatment procedure for the material. The cycle time at each temperature shall not exceed that for the casting(s).

11.3 Test specimens may be cut from heat-treated castings, at the producer's option, instead of from test bars.

11.4 If any specimen shows defective machining, or exhibits flaws, it may be discarded and another substituted from the same heat.

12. Repair by Welding

12.1 Weld repairs shall be inspected to the same quality standards that are used to inspect the castings. When castings are produced with Supplementary Requirement S1 specified, weld repairs shall be inspected by magnetic particle examination to the same standards that are used to inspect the castings. When castings are produced with Supplementary Requirement S2 specified, weld repairs in which the depth of the cavity prepared for repair welding exceeds 20 % of the wall thickness or 1 in. [25 mm], whichever is smaller, or in which the cavity prepared for welding is greater than approximately 10 in.^{2}[65 cm^2], shall be radiographed to the same standards that are used to inspect the castings.

12.2 Welds exceeding 20 % of the wall thickness or 1 in. [25 mm], whichever is smaller, or exceeding approximately 10 in.^{2} [65 cm^2] in area, shall be given a suitable stress relief or heat treatment.

13. Rehearing

13.1 Tested samples representing rejected material shall be held for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

14. Keywords

14.1 alloy steel; carbon steel; castings; high strength steel; martensitic stainless steel; steel castings; structural castings

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall not apply unless specified in the purchase order. A list of standardized supplementary requirements for use at the option of the purchaser is included in Specification A 781/A 781M. Those which are ordinarily considered suitable for use with this specification are given below together with additional supplementary requirements that are applicable only to this specification. Other supplementary requirements enumerated in Specification A 781/A 781M may be used with this specification upon agreement between the manufacturer and purchaser.

S1. Magnetic Particle Examination.

S2. Radiographic Examination.

S6. Certification.

S8. Marking.

S9. Charpy Impact Test

S9.1 Charpy impact test properties shall be determined on each heat from a set of three Charpy V-notch specimens made from a test coupon in accordance with Test Methods and Definitions A 370 and tested at a test temperature agreed upon between the manufacturer and purchaser. The acceptance requirements shall be either energy absorbed, lateral expansion, or percent shear area, or all three, and shall be that agreed upon by the manufacturer and purchaser. Test specimens shall be prepared and tested in accordance with Test Methods and Definitions A 370.

S9.2 *Absorbed Energy*—Average energy value of three specimens shall be not less than specified, with not more than one value permitted to fall below the minimum specified and no value permitted below the minimum specified for a single specimen.

S9.3 *Lateral Expansion*—Lateral expansion value shall be agreed upon between the manufacturer and purchaser.

S9.4 *Percent Shear Area*—Percent shear area shall be agreed upon between the manufacturer and purchaser.

S15. Alternate Tension Test Coupons and Specimen Locations for Castings (in lieu of Test Bars Poured from Special Blocks).

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 148/A 148M – 05) that may impact the use of this standard (Approved March 1, 2008).

(*1*) Removed Type A from S.9.1 Charpy Impact Test.

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