



Designation: A148/A148M – 20

# Standard Specification for Steel Castings, High Strength, for Structural Purposes<sup>1</sup>

This standard is issued under the fixed designation A148/A148M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. 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 [A27/A27M](#).

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 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 nonconformance with the standard.

1.3.1 Within the text, the SI units are shown in brackets.

1.4 *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:*<sup>2</sup>

[A27/A27M Specification for Steel Castings, Carbon, for General Application](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A781/A781M Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use](#)

[A957/A957M Specification for Investment Castings, Steel](#)

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[and Alloy, Common Requirements, for General Industrial Use](#)

[A1067/A1067M Specification for Test Coupons for Steel Castings](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

## 3. General Conditions for Delivery

3.1 Except for castings produced by the investment casting process, material furnished to this specification shall conform to the requirements of Specification [A781/A781M](#), including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification [A781/A781M](#) constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification [A781/A781M](#), this specification shall prevail.

3.2 Investment castings furnished to this specification shall conform to the requirements of Specification [A957/A957M](#), including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification [A957/A957M](#) constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification [A957/A957M](#), Specification [A957/A957M](#) shall prevail.

## 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.

4.1.5 In the case of quench and tempered castings the ruling section, T.

## 5. Heat Treatment

5.1 All castings shall be heat treated either by annealing, normalizing, normalizing and tempering, or quenching and

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

**TABLE 1 Chemical Composition Requirements<sup>A</sup>**

Grade (UNS Number)	Element, %	
	Phosphorus	Sulfur
80-40 [550-275] (D50400)	0.05	0.06
80-50 [550-345] (D50500)	0.05	0.06
90-60 [620-415] (D50600)	0.05	0.06
105-85 [725-585] (D50850)	0.05	0.06
115-95 [795-655] (D50950)	0.05	0.06
130-115 [895-795] (D51150)	0.05	0.06
135-125 [930-860] (D51250)	0.05	0.06
150-135 [1035-930] (D51350)	0.05	0.06
160-145 [1105-1000] (D51450)	0.05	0.06
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

<sup>A</sup> All values are maximums.

**TABLE 2 Tensile Requirements<sup>A</sup>**

Grade	Tensile strength, ksi [MPa]	Yield Strength, ksi [MPa] <sup>B</sup>	Elongation in 2 in. or 50 mm, %	Reduction of Area, %
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]	165 [1140]	150 [1035]	5	20
210-180 [1450-1240]	210 [1450]	180 [1240]	4	15
210-180L [1450-1240L]	210 [1450]	180 [1240]	4	15
260-210 [1795-1450]	260 [1795]	210 [1450]	3	6
260-210L [1795-1450L]	260 [1795]	210 [1450]	3	6

<sup>A</sup> All values are minimums.

<sup>B</sup> Determine by the 0.2 % offset method.

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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.

## 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. Tension Testing Requirements

8.1 One tension test shall be made from each heat, for investment castings, each master 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 **A370** 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 **A370**.

8.4 To determine conformance with the tension test requirements, an observed value or calculated value shall be rounded off in accordance with Practice **E29** 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 **A781/A781M**.

9.2 The impact properties of each heat, for investment castings, each master heat, shall be determined by testing one set of three Charpy V-notch impact specimens at  $-40 \pm 2$  °F [ $-40 \pm 1$  °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 **A370**, 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, for investment castings, the same master heat, as the castings represented. Test coupons may be cast integrally with the castings or as separate blocks similar to those shown in Specification **A1067/A1067M**.

11.1.1 In the case of quenched and tempered castings where the ruling section, T, exceeds 3 in., Supplementary Requirement S15 of Specification **A781/A781M** shall apply with the

casting's thickness, T, in **A781/A781M**, S15.2 equal to the ruling section, T, from **4.1.5**. For investment castings, Supplementary Requirement S15 of Specification **A957/A957M** shall apply.

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.<sup>2</sup> [65 cm<sup>2</sup>], shall be radiographed to the same standards that are used to inspect the castings. [4a/astm-a148-a148m-20](#)

12.2 Welds exceeding 20 % of the wall thickness or 1 in. [25 mm], whichever is smaller, or exceeding approximately 10 in.<sup>2</sup> [65 cm<sup>2</sup>] 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

**TABLE 3 Charpy V-Notch Impact Requirements**

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