



Designation: **A148/A148M – 15a** **A148/A148M – 19**

## 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 ~~non-conformance~~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 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),

<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, 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



TABLE 1 Chemical Requirements

| Grade (UNS No.)                | Composition, % |                 |
|--------------------------------|----------------|-----------------|
|                                | Sulfur, max    | Phosphorus, max |
| 80-40 [550-275] (D50400)       | 0.06           | 0.05            |
| 80-40 [550-275] (D50400)       | 0.06           | 0.05            |
| 80-50 [550-345] (D50500)       | 0.06           | 0.05            |
| 80-50 [550-345] (D50500)       | 0.06           | 0.05            |
| 90-60 [620-415] (D50600)       | 0.06           | 0.05            |
| 90-60 [620-415] (D50600)       | 0.06           | 0.05            |
| 105-85 [725-585] (D50850)      | 0.06           | 0.05            |
| 105-85 [725-585] (D50850)      | 0.06           | 0.05            |
| 115-95 [795-655] (D50950)      | 0.06           | 0.05            |
| 115-95 [795-655] (D50950)      | 0.06           | 0.05            |
| 130-115 [895-795] (D51150)     | 0.06           | 0.05            |
| 130-115 [895-795] (D51150)     | 0.06           | 0.05            |
| 135-125 [930-860] (D51250)     | 0.06           | 0.05            |
| 135-125 [930-860] (D51250)     | 0.06           | 0.05            |
| 150-135 [1035-930] (D51350)    | 0.06           | 0.05            |
| 150-135 [1035-930] (D51350)    | 0.06           | 0.05            |
| 160-145 [1105-1000] (D51450)   | 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           |

TABLE 2 Tensile Requirements

| Grade                 | Tensile strength min, ksi [MPa] | Yield point min, ksi [MPa] | Elongation in 2 in. or 50 mm, min, % | 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] | 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                         |

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 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.

## 6. Temperature Control

6.1 Furnace temperatures for ~~heat-treating~~ 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~~Grades 165-150L [1140-1035L], 210-180L [1450-1240L], and 260-210L [1795-1450L].

NOTE 1—Other grades may be ordered to ~~Charpy~~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°-40 ± 2°F [-40°2 °F [-40 ± 4°C].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~~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 three inches, supplementary requirement~~T, exceeds 3 in., Supplementary Requirement S15 of Specification **A781/A781M** shall apply with the casting’s

**TABLE 3 Impact Requirements**

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