



Designation: A 278M – 93^{ε1}
METRIC

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 350°C¹

This standard is issued under the fixed designation A 278M; 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.

^{ε1} NOTE—The Tensile Requirements table was corrected editorially in July 1996.

1. Scope

1.1 This specification covers gray iron for castings suitable for pressure-containing parts for use at temperatures up to 350°C.

1.2 Castings of all classes are suitable for use up to 230°C. For temperatures above 230°C and up to 350°C, only Class 275, 300, 325, 350, 380, and 415 castings are suitable.

1.3 This specification is the SI companion to Specification A 278.

2. Referenced Documents

2.1 ASTM Standards:

- A 278 Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F²
- A 644 Terminology Relating to Iron Castings²
- E 8 Test Methods for Tension Testing of Metallic Materials³

3. Terminology

3.1 Definitions of many terms common to gray iron castings may be found in Terminology A 644.

4. Classification

4.1 Castings ordered to this specification are classified based upon the minimum tensile strength of the iron in MPa. Class 150 has a minimum specified tensile strength of 150 MPa.

5. Ordering Information

5.1 Orders for material in this specification should include the following information:

- 5.1.1 ASTM designation and year date,
- 5.1.2 Class of iron required and service temperature,
- 5.1.3 Quantity,

¹ This specification is under the jurisdiction of ASTM Committee A-4 on Iron Castings and is the direct responsibility of Subcommittee A04.01 on Gray Iron Castings.

Current edition approved Aug. 15, 1993. Published November 1993. Originally published as A 278M – 85. Last previous edition A 278M – 85(1991).

² Annual Book of ASTM Standards, Vol 01.02.

³ Annual Book of ASTM Standards, Vol 03.01.

5.1.4 Whether or not heat treatment is required for Class 275, 300, 325, 350, 380, and 415 castings to be used at temperatures at 230°C or less (see 6.2),

5.1.5 The size of separately cast test bar to be poured (see Section 9 and Table 1),

5.1.6 The size of test specimen to be machined from test bars C or S, and

5.1.7 Special requirements.

6. Materials and Manufacture

6.1 Castings intended for use above 230°C shall be stress-relieved by placing them in a suitable furnace at a temperature not exceeding 200°C and heating them uniformly to the temperatures and for the times specified in Table 2. The heating and cooling rates shall be uniform and shall not be more than 250°C/h for castings of 25 mm maximum section. For heavier sections the maximum heating and cooling rates in degrees Celsius per hour shall be 5000 divided by the maximum section thickness.

6.2 Castings of Class Nos. 275, 300, 325, 350, 380, and 415, which are to be used at temperatures below 230°C, may be heat treated in accordance with 6.1 or they shall be cooled in the mold to 250°C at an average rate of not more than 50°C/h for castings up to 25 mm in section. For heavier sections the maximum cooling rate in degrees Celsius per hour shall be 1250 divided by the maximum section thickness.

7. Chemical Composition

7.1 Class 275, 300, 325, 350, 380, and 415 castings intended for service above 230°C shall have a maximum carbon equivalent of 3.8 % as calculated from the equation $CE = \%C + 0.3 (\%Si + \%P)$. The maximum phosphorus and sulfur contents shall be 0.25 % and 0.12 %, respectively.

7.2 The chemical analysis for total carbon shall be made on either chilled cast pencil-type specimens or thin wafers approximately 1/32 in. thick cut from test coupons. Drillings shall not be used because of attendant loss of graphite.

8. Tensile Requirements

8.1 Iron used in supplying castings to this specification shall

TABLE 1 Diameters and Lengths of Cast Test Bars

Test Bar	As-Cast Diameter, mm			Length, mm	
	Nominal (Mid-Length)	Minimum (Bottom)	Maximum (Top)	Minimum (Specified)	Maximum (Recommended)
A	23	22	25	125	150
B	33	32	36	150	230
C	54	53	58	175	255
S ^A					

^AAll dimensions of Test Bar S shall be as agreed upon by the manufacturer and the purchaser.

TABLE 2 Stress Relieving Requirements

Class	Metal Temperature, °C	Holding Time, h ^A	
		Minimum	Maximum
275, 300, 325, 350, 380, 415	565 to 650	2	12

^AIn no case shall the holding time be less than 1 h for every 25 mm metal section, or in excess of 12 h maximum, depending upon which governs.

conform to the tensile requirements prescribed in Table 3.

9. Test Bars

9.1 Separately cast test bars having the dimensions shown in Table 1 shall be poured from the same lot as the castings represented. The size of the test bar to be poured shall be selected by the purchaser using Table 4. In the event no choice is made, the selection will be made by the manufacturer.

9.2 Separately cast test bars shall be heat treated in the same furnace together with the castings represented.

9.3 At the option of the manufacturer, test coupons may be removed from the castings at a location agreed upon between the manufacturer and purchaser.

9.4 Castings weighing in excess of 1000 kg may be represented either by separately cast test bars (9.1) or by integrally cast test bars having a cooling rate closely approximating that of the controlling section of the casting.

9.5 For castings weighing in excess of 5000 kg or having a controlling section greater than 50 mm, test bars may be removed from the casting or integral projections having a cross section no less than the controlling section. The minimum tensile strength requirement for tension tests performed on either of these test bars shall be 80 % of the specified class.

10. Molding and Pouring Test Bars

10.1 The test bars shall be cast in dried siliceous sand molds maintained at approximately room temperature. A suitable design for a mold is shown in Fig. 1.

TABLE 3 Tensile Requirements

Class	Tensile Strength min, MPa
No. 150	150
No. 175	175
No. 200	200
No. 225	225
No. 250	250
No. 275	275
No. 300	300
No. 325	325
No. 350	350
No. 380	380
No. 415	415

TABLE 4 Separately Cast Test Bars for Use When a Specific Correlation Has Not Been Established Between the Test Bar and the Casting

Thickness of the Wall of the Controlling Section of the Casting, mm	Test Bar
Under 6	S
6–12	A
13–25	B
26–50	C
Over 50	S

11. Workmanship, Finish, and Appearance

11.1 All castings shall be made in a workmanlike manner and shall conform to the dimensions on drawings furnished by the purchaser. If the pattern is supplied by the purchaser without drawings, the dimensions of the casting shall be as predicted by the pattern.

11.2 The surface of the casting shall be free of adhering sand, scale, cracks, and hot tears as determined by visual examination. Other surface discontinuities shall meet the visual acceptance standards specified in the order.

12. Number of Tests and Retests

12.1 One tension test shall be performed on each lot in accordance with Test Method E 8 and conform to the tensile requirements specified.

12.2 If the results of a valid test fail to conform to the requirements of this specification, two retests shall be made. If either retest fails to meet the specification requirements, the castings represented by these test specimens shall be rejected.

12.3 If, after testing, a test specimen shows evidence of a defect, the results of the test may be invalidated and another made on a specimen from the same lot.

13. Sampling

13.1 A lot shall consist of one of the following:

13.1.1 All the metal poured from a single heating in a batch type melting furnace,

13.1.2 All the metal from two or more batch type melting furnaces poured into a single ladle or single casting, or

13.1.3 All the metal poured from a continuous melting furnace for a given period of time between changes in charge, processing conditions, or aim-for chemistry or 4 h, whichever is the shorter period.

13.1.3.1 The purchaser may agree to extend the 4-h time period to 8 h if the manufacturer can demonstrate sufficient process control to warrant such an extension.

14. Tension Test Specimens

14.1 Tension test specimens A and B in Fig. 2 shall be machined from test bars A and B in Table 1, respectively.

14.2 The purchaser shall specify whether test specimen B or C is to be machined from test bar C. If no choice is made, the manufacturer shall make the selection.

14.3 The size of the test specimen to be machined from test bar S shall be as agreed upon between the manufacturer and purchaser.

15. Repair

15.1 Any repairs performed on castings produced to this