



# Standard Specification for Corrosion-Resistant High-Silicon Iron Castings<sup>1</sup>

This standard is issued under the fixed designation A 518/A 518M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

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

## 1. Scope

1.1 This specification covers high-silicon cast iron castings intended for corrosion-resistant service.

1.2 This specification covers three grades as shown in Table 1. Selection of grade depends on the corrosive service to be experienced by the casting. All three grades are suited for application in severe corrosive environments. However, Grade 2 is particularly suited for application in strong chloride environments, and Grade 3 is recommended for impressed current anodes.

1.3 The values stated in either 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 shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 The following safety hazards caveat pertains only to the test method portion, Section 9, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

A 438 Test Method for Transverse Testing of Gray Cast Iron<sup>2</sup>

E 350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron<sup>3</sup>

E 351 Test Methods for Chemical Analysis of Cast Iron—All Types<sup>3</sup>

## 3. Ordering Information

3.1 Orders for material under this specification shall include

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<sup>2</sup> Annual Book of ASTM Standards, Vol 01.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.05.

TABLE 1 Chemical Composition

Element	Composition, Weight %		
	Grade 1	Grade 2	Grade 3
Carbon	0.65–1.10	0.75–1.15	0.70–1.10
Manganese	1.50, max	1.50, max	1.50, max
Silicon	14.20–14.75	14.20–14.75	14.20–14.75
Chromium	0.50, max	3.25–5.00	3.25–5.00
Molybdenum	0.50, max	0.40–0.60	0.20, max
Copper	0.50, max	0.50, max	0.50, max

the following information:

3.1.1 ASTM designation and year of issue.

3.1.2 Grade of high-silicon cast iron (see Section 5).

3.1.3 Number of castings.

3.1.4 Approximate weight of the casting.

3.1.5 Drawing showing the size, shape, dimensions, and finishing details. The drawing should indicate any critical dimensions and should give the allowable tolerances on all dimensions and on the accumulation of dimensions. If the purchaser supplies the pattern, the dimensions of the casting shall conform to those predicted by the pattern.

3.1.6 Options in this specification, including:

3.1.6.1 The status of the heat treatment of the castings when shipped by the manufacturer (see Section 7).

3.1.6.2 If the chemical analysis and mechanical test results are to be reported to the purchaser (see Section 14).

3.1.6.3 If a transverse test is required (see 8.1).

3.1.6.4 If hydraulic testing is required, and, if required, the test pressure and the leakage permitted (see 8.2).

3.1.6.5 Any special packing, markings, etc.

## 4. Method of Manufacture

4.1 The alloy may be produced by any melting and casting process, or combination of processes, capable of meeting the chemical composition and mechanical properties specified.

## 5. Chemical Composition

5.1 High-silicon iron castings are produced in one of three grades, as given in Table 1 of this specification.

## 6. Chemical Analysis

6.1 *Heat Analysis*—Chemical analysis of each heat (or each tap, if from a continuous melting operation) shall be made by the manufacturer to determine the percentages of the elements specified in Table 1. The analysis shall be made from a test

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sample cast during the pouring of the heat (or tap). The chemical composition thus determined shall conform to the requirements specified for that grade in Table 1.

6.2 *Product Analysis*—A product analysis may be made by the purchaser from material representing each heat, lot, or casting. The sample for such analysis shall be taken as desired by the purchaser. The chemical composition thus determined shall meet the requirements for the grade specified.

6.3 *Routine Analysis Methods*—Spectrometric and other instrumental methods or wet chemical laboratory methods are acceptable for routine and control determinations, but shall be standardized against and give essentially the same results as the methods specified in 6.4.

6.4 *Reference Analysis Methods:*

6.4.1 *Silicon:*

6.4.1.1 Analyze samples soluble when processed in accordance with Test Methods E 350, by that method, except as follows:

(a) (a) The sample weight shall be 0.3 g with a weight tolerance of  $\pm 0.1$  mg.

(b) (b) Pulverize one or more pieces of the sample until the entire material in the piece or pieces passes through a 100-mesh screen.

(c) (c) Dissolve the sample in 25 mL of perchloric acid.

6.4.1.2 Analyze samples that are not soluble when processed in accordance with 6.4.1.1 in accordance with Annex A1.

6.4.2 *Molybdenum:*

6.4.2.1 Mill, lathe, or pulverize the sample to pass through a 100-mesh sieve. If the sample is soluble when processed in accordance with Test Methods E 350, use this method.

6.4.2.2 If the sample is not acid-soluble when processed in accordance with 6.4.2.1, proceed as follows:

(a) (a) Use the appropriate weight of sample in accordance with 6.4.2.1 instead of the weight given in A1.2.3 of Annex A1.

(b) (b) Fuse the sample in accordance with A1.2.1 and A1.2.2 and A1.2.4-A1.2.12 of Annex A1.

(c) (c) Add the amount of dissolving acid(s), specified in the sections in Molybdenum by the Photometric Method in Test Methods E 350, heat to fumes of perchloric acid. Proceed in accordance with Test Methods E 350.

6.4.3 *Carbon*—Determine carbon in accordance with sections on Carbon, Total, by the Combustion Gravimetric Method, in Test Methods E 350.

6.4.4 *Manganese:*

6.4.4.1 Mill, lathe, or pulverize the sample to pass through a 100-mesh sieve.

6.4.4.2 Determine manganese in accordance with the sections on Manganese by the Peroxydisulfate-Arsenite Titrimetric Method in Test Methods E 350. Add hydrofluoric acid as required for complete solution of the (HF) sample.

6.4.5 *Chromium:*

6.4.5.1 Mill, lathe, or pulverize the sample to pass through a 100-mesh sieve.

6.4.5.2 Determine chromium in accordance with the sections on Chromium by the Peroxydisulfate-Oxidation Titrimetric Method in Test Methods E 350, except dissolve the sample as follows:

(a) (a) Place the appropriate amount of weighed sample into a 600-mL Griffin beaker or 500-mL volumetric flask. Add 20 mL of nitric acid ( $\text{HNO}_3$ ) and carefully add HF, dropwise, until the reaction ceases. A TFE-fluorocarbon beaker may be used if desired.

(b) (b) Add 30 mL of 1 + 1 sulfuric acid ( $\text{H}_2\text{SO}_4$ ), 5 mL of phosphoric acid ( $\text{H}_3\text{PO}_4$ ), and boil until light fumes of  $\text{H}_2\text{SO}_4$  are present and the sample is completely dissolved.

(c) (c) Cool the solution, add 150 mL of water, heat to dissolve if necessary, and continue as in Test Methods E 350.

6.4.6 *Copper:*

6.4.6.1 Mill, lathe, or pulverize the sample to pass through a 100-mesh sieve.

6.4.6.2 Determine the copper in accordance with the sections on Copper by the Sulfide Precipitation-Electrodeposition Gravimetric Method in Test Methods E 350, or

6.4.6.3 Determine the copper in accordance with the sections on Copper by the Neocuproine Photometric Method, in Test Methods E 350. Add HF as required for complete solution of the sample.

**7. Heat Treatment**

7.1 High-silicon iron castings are generally used in the heat-treated (stress-relieved) condition. Small castings of simple configuration not conducive to high-residual stresses may be used in the as-cast condition. If the castings are to be supplied in the stress-relieved condition, the purchaser must so specify.

7.2 At its option, the foundry may heat treat the castings to remove stresses without the purchaser so specifying.

7.3 If used, the stress-relieving heat treatment shall be as follows:

7.3.1 Heat at a rate that will not crack the castings.

7.3.2 Hold the castings at a minimum temperature of 1600°F [870°C] for a minimum period of 1 h/in. [mm] of maximum section thickness, except that in no case shall the holding period be less than 2 h.

7.3.3 Cool the castings to 400°F [205°C] maximum at a rate not faster than 100°F [55°C]/15 min.

7.3.4 From 400°F [205°C] to ambient temperature, the castings may be cooled in still ambient air.

**8. Mechanical Requirements**

8.1 *Transverse Bend Test:*

8.1.1 When specified by the purchaser, the silicon-iron alloy shall be given a transverse bend test. The specimen tested shall meet the test requirements prescribed in Table 2.

8.1.2 When transverse bend tests are specified, test bars shall be made and tested from each heat (or ladle in the case of continuous melting) from which the castings are poured.

8.1.3 The test bars shall be heat treated in the production furnaces to the same procedure as the castings.

8.1.4 Each test bar shall be permanently marked with the

**TABLE 2 Transverse Bend Test Minimum Requirements**

NOTE 1—Test bars are to be tested on supports 12 in. [3.5 mm] apart.

Load at center, min, lbf [N]	930 [4090]
Deflection at center, min, in. [mm]	0.026 [0.66]