



Designation: A 100 – 93 (Reapproved 2000)

## Standard Specification for Ferrosilicon<sup>1</sup>

This standard is issued under the fixed designation A 100; 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.

### 1. Scope

1.1 This specification covers seven regular grades of ferrosilicon for steelmaking and foundry uses designated A, B, C, D, E, F, and G, and subgrades designated as low-aluminum, boron-bearing, and calcium-bearing.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units (SI units) given in parentheses may be approximate.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

E 11 Specification for Wire-Cloth Sieves for Testing Purposes<sup>2</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>2</sup>

E 32 Practices for Sampling Ferroalloys and Steel Additives for Determination of Chemical Composition<sup>3</sup>

E 360 Test Methods for Chemical Analysis of Silicon and Ferrosilicon<sup>4</sup>

### 3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Quantity,

3.1.2 Name of material,

3.1.3 ASTM designation and year of issue,

3.1.4 Grade,

3.1.5 Size, and

3.1.6 Requirements for packaging, analysis reports, etc. as appropriate.

3.2 Although ferrosilicon is purchased by total net weight, the customary basis of payment is per pound of contained silicon.

### 4. Chemical Composition

4.1 The various grades shall conform to the requirements as to chemical composition prescribed in Table 1, Table 2, Table 3, and Table 4.

4.2 The manufacturer shall furnish an analysis of each shipment showing the silicon content and when required, such of the other elements specified in Table 1 and Table 2.

4.3 The values shown in Table 3 and Table 4 are expected maximums. Upon request of the purchaser, the manufacturer shall furnish an analysis of any of these elements on a schedule mutually agreed upon between the manufacturer and the purchaser.

### 5. Size

5.1 The various grades are available in sizes as listed in Table 5.

5.2 The sizes listed in Table 5 are typical as shipped from the manufacturer's plant. These alloys exhibit varying degrees of friability; therefore, some attrition may be expected in transit, storage, and handling. A quantitative test is not available for rating relative friability of ferroalloys. A code system has been developed, therefore, for this purpose, and a number rating for each product type is shown in the last column of Table 5. Definitions applicable to these code numbers are given in Table X1.2.

### 6. Sampling

6.1 The material shall be sampled in accordance with Practices E 32.

6.2 Other methods of sampling mutually agreed upon between the manufacturer and the purchaser may be used; however, in case of discrepancy, Practices E 32 shall be used for referee.

### 7. Chemical Analysis

7.1 The chemical analysis of the material shall be made in accordance with the procedure for ferrosilicon as described in Methods E 360 or alternative methods that will yield equivalent results.

7.2 If alternative methods of analysis are used, in case of discrepancy, Methods E 360 shall be used for referee.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A-1 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> Annual Book of ASTM Standards, Vol 14.02.

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

<sup>4</sup> Annual Book of ASTM Standards, Vol 03.06.



7.3 Where no method is given in Methods E 360 for the analysis for a particular element, the analysis shall be made in accordance with a procedure agreed upon between the manufacturer and the purchaser.

8. Inspection

8.1 The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

9. Rejection

9.1 Any claims or rejections shall be made to the manufacturer within 45 days from receipt of material by the purchaser.

10. Packaging

10.1 The material shall be packaged in sound containers, or shipped in bulk, in such a manner that none of the product is lost or contaminated in shipment.

TABLE 1 Chemical Requirements<sup>A</sup>—Steel Making Grades

Table with 6 columns: Element, Grade C<sup>B,C</sup>, Grade D<sup>C</sup>, Grade E<sup>D</sup>, Grade F, Grade G<sup>E</sup>. Rows include Silicon, Carbon, Sulfur, Phosphorus, Aluminum, and Manganese with their respective composition ranges.

<sup>A</sup>For purposes of determining conformance with this specification, the reported analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of Recommended Practice E 29.
<sup>B</sup>For low-aluminum grades, aluminum specification is 0.50 %, max.
<sup>C</sup>A high purity grade is available (0.10 max, aluminum).
<sup>D</sup>For low-aluminum grade, aluminum specification is 0.40 %, max.
<sup>E</sup>Manganese content over 1.25 % may be specified as agreed.

TABLE 2 Chemical Requirements<sup>A</sup>—Foundry Grades

Table with 6 columns: Element, Grade C 1, Grade C 2, Grade E 1<sup>B,C</sup>, Grade F 1<sup>C</sup>, Grade G 1<sup>C,D</sup>. Rows include Silicon, Carbon, Sulfur, Phosphorus, Aluminum, Manganese, Calcium, and Boron with their respective composition ranges.

<sup>A</sup>For purposes of determining conformance with this specification, the reported analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of Recommended Practice E 29.
<sup>B</sup>Grade E in Table 1 is suitable for foundry use.
<sup>C</sup>Boron content may be specified within a range from 0.04 to 0.10 %. When shipped in 3000-lb containers, the average boron content of a container shall not vary from the average reported for the entire shipment by more than 0.010 %.
<sup>D</sup>Manganese content over 1.25 % may be specified as agreed.

TABLE 3 Supplementary Chemical Requirements<sup>A</sup>—Steel Making Grades

Table with 4 columns: Element, C, D, E. Rows include Chromium, Nickel, Copper, and Titanium with their maximum percentages for grades C, D, and E.

<sup>A</sup>For purposes of determining conformance with this specification, the reported analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of Recommended Practice E 29.

TABLE 4 Supplementary Chemical Requirements<sup>A</sup>—Foundry Grades

Table with 4 columns: Element, Grade E 1, Grade F 1, Grade G 1. Row includes Chromium with its maximum percentage for grades E 1, F 1, and G 1.



**TABLE 4** *Continued*

Element	Composition, %		
	Grade E 1	Grade F 1	Grade G 1
Titanium, max	0.20	0.20	0.20

<sup>4</sup> For purposes of determining conformance with this specification, the reported analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of Recommended Practice E 29.



TABLE 5 Standard Sizes and Tolerances

Grades	Standard Sizes	Tolerances and Sieve Sizes Defined by ASTM Specification E 11		Friability Rating <sup>A</sup>
A	8-in. (203-mm) by 2-in. (50.8-mm)	60-lb (27.2-kg) lump, max	10 %, max, passing 2-in. (50.8-mm) sieve	Grade A-4
	4-in. (102-mm) by down	10 %, max, retained on 4-in. (102-mm) sieve	12 %, max, passing ¼-in. (6.35-mm) sieve	
	2-in. (50.8-mm) by down	10 %, max, retained on 2-in. (50.8-mm) sieve	15 %, max, passing No. 8 (2.38-mm) sieve	
B,C,D,E	8-in. (203-mm) by 4-in. (102-mm)	90-lb (40.8-kg) lump, max	10 %, max, passing 4-in. (102-mm) sieve	Grade B-4
	8-in. (203-mm) by 2-in. (50.8-mm)	90-lb (40.8-kg) lump, max	10 %, max, passing 2-in. (50.8-mm) sieve	Grade C-4
	5-in. (127-mm) by 2-in. (50.8-mm)	10 %, max, retained on 5-in. (127-mm) sieve	10 %, max, passing 2-in. (50.8-mm) sieve	Grade E-5
	4-in. (102-mm) by ½-in. (12.7-mm)	10 %, max, retained on 4-in. (102-mm) sieve	10 %, max, passing ½-in. (12.7-mm) sieve	
	4-in. (102-mm) by down	10 %, max, retained on 4-in. (102-mm) sieve	12 %, max, passing ¼-in. (6.35-mm) sieve	
	3-in. (76.2-mm) by ½-in. (12.7-mm)	10 %, max, retained on 3-in. (76.2-mm) sieve	15 %, max, passing ½-in. (12.7-mm) sieve	
	3-in. (76.2-mm) by down	10 %, max, retained on 3-in. (76.2-mm) sieve	15 %, max, passing No. 8 (2.38-mm) sieve	
	2-in. (50.8-mm) by ½ in. (12.7-mm)	10 %, max, retained on 2-in. (50.8-mm) sieve	15 %, max, passing ½-in. (12.7-mm) sieve	
	2-in. (50.8-mm) by down	10 %, max, retained on 2-in. (50.8-mm) sieve	15 %, max, passing No. 8 (2.38-mm) sieve	
	1-in. (25.4-mm) by No. 8 (2.38-mm)	5 %, max, retained on 1-in. (25.4-mm) sieve	10 %, max, passing No. 8 (2.38-mm) sieve	
1-in. (25.4-mm) by down	5 %, max, retained on 1-in. (25.4-mm) sieve	20 %, max, passing No. 8 (2.38-mm) sieve		
C,D,F	Lump or Pig	90-lb (40.8-kg) lump or pig, max		Grade C-4 D and F-4
A,B,C,D,E	½-in. (12.7-mm) by No. 8 (2.38-mm)	5 %, max, retained on ½-in. (12.7-mm) sieve	10 %, max, passing No. 8 (2.38-mm) sieve	Grade A-4
	¾-in. (9.51-mm) by No. 6 (3.36-mm)	5 %, max, retained on ¾-in. (9.51-mm) sieve	10 %, max, passing No. 6 (3.36-mm) sieve	Grade B-4
	¾-in. (9.51-mm) by No. 12 (1.68-mm)	5 %, max, retained on ¾-in. (9.51-mm) sieve	10 %, max, passing No. 14 (1.41-mm) sieve	Grade C-4
	¾-in. (9.51-mm) by down	5 %, max, retained on ¾-in. (9.51-mm) sieve	15 %, max, passing No. 70 (0.21-mm) sieve	Grade D-4
	¼-in. (6.35-mm) by down	5 %, max, retained on ¼-in. (6.35-mm) sieve		Grade E-5
	No. 8 (2.38-mm) by down	5 %, max, retained on No. 8 (2.38-mm) sieve		
	No. 28 (841-µm) by down	5 %, max, retained on No. 20 (841-µm) sieve		
G	pig	90-lb (40.8-kg) pig, max.		Grade G-2

<sup>A</sup>See Appendixes.

## APPENDIX

### (Nonmandatory Information)

#### X1. FRIABILITY RATINGS

X1.1 Proposed friability ratings are shown in Tables X1.1 and X1.2 as follows:

**TABLE X1.1 Proposed Friability Ratings for Ferrosilicon**

Product Grade	Composition, %	Proposed Friability Rating
A	92.0–95.0 Si	4
B	82.0–88.0 Si	4
B-1	83.0–88.0 Si, 0.5 Ca	4
B-2	83.0–88.0 Si, 1.5 Ca	4
C	74.0–79.0 Si	4
C-1	74.0–79.0 Si, 0.5 Ca	4
C-2	74.0–79.0 Si, 1.5 Ca	4
D	65.0–70.0 Si	4
E	47.0–51.0 Si	5
E-1	47.0–51.0 Si, 0.04–0.10 B	5
F	20.0–24.0 Si	4
F-1	20.0–24.0 Si, 0.04–0.10 B	4
G	14.0–17.0 Si	2
G-1	14.0–17.0 Si, 0.04–0.10 B	2

**TABLE X1.2 Friability Ratings**

Code No.	Definition
1	Very tough materials that are susceptible to little, if any, breakage during shipment or handling. (Example: low-carbon ferrochrome).
2	Some breakage of large pieces probable in shipping and handling. No appreciable fines produced from either lump or crushed sizes. (Example: chrome metal).
3	Appreciable reduction in size of large pieces possible in shipping and handling. No appreciable production of fines in handling of crushed sizes. (Example: ferrovanadium).
4	Appreciable reduction in size of large pieces upon repeated handling. Some fines produced upon repeated handling of crushed sizes. (Example: standard ferromanganese).
5	Appreciable reduction in size in repeated handling of large pieces. Appreciable fines may be produced in the handling of crushed sizes. (Example: 50 % ferrosilicon).
6	This category represents the most friable alloys. (Example: calcium silicon).

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