Designation: A ~~100 – 93 (Reapproved 2000)~~ 100 – 04

Standard Specification for Ferrosilicon[1]

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 (ε) 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.~~ uses.

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.

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[1] This specification is under the jurisdiction of ASTM Committee ~~A-1~~ A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.18 on Castings.

Current edition approved ~~Dec. 15, 1993.~~ May 1, 2004. Published ~~April 1994.~~ May 2004. Originally ~~published as A 100 – 25.~~ approved in 1925. Last previous edition ~~A 100 – 80 (1986).~~ approved in 1993 as A 100 – 93 (2000).

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

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 1025 Specification for Ferroalloys, General Requirements
E 11 Specification for Wire- Cloth and Sieves for Testing Purposes
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E 32 Practices for Sampling Ferroalloys and Steel Additives for Determination of Chemical Composition
E 360 Test Methods for Chemical Analysis of Silicon and Ferrosilicon

3. Ordering Information

3.1 Orders for material underGeneral Conditions of Delivery
3.1 Materials furnished to this specification shall include conform to the following information:
3.1.1 Quantity,
3.1.2 Name requirements 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, Specification A 1025, including any supplementary requirements that are indicated in the customary basis purchase order. Failure to comply with the general requirements of payment is per pound Specification A 1025 constitutes nonconformance with this specification. In case of conflicta between the requirements of this specification and Specification A 1025, this specilfication shall prevail.

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. 1.

5. Size

5.1 The various grades are available in sizes as listed in Table 5 2.

5.2 The sizes listed in Table 5 2 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. 2. Definitions applicable to these code numbers are given in Table X1.2. Specification A 1025.

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

76.1 TUnless otherwise agreed upon, the chemical analysis of the material shall be made in accordance with the procedure for ferrosilicon as described in Test Methods E 360 or E 360.

6.2 If 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.

76.3 Where no a method is not 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.

[2] 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*, Vol 14.02. volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Chemical Requirements

Element	Grade																	
	C	CA	CB	C1	C2	D	DA	E	EA	E1	E1A	F	F1	F1A	G	GA	G1	G1A
	Composition, %[A,B]																	
Silicon	74.0–79.0	74.0–79.0	74.0–79.0	74.0–79.0	74.0–79.0	65.0–67.0	65.0–67.0	47.0–51.0	47.0–51.0	47.0–51.0	47.0–51.0	20.0–24.0	20.0–24.0	20.0–24.0	14.0–17.0	14.0–17.0	14.0–17.0	14.0–17.0
Carbon	0.10	0.10	0.10	0.10	0.10	0.10	0.10	.010	.010	0.10	0.10	0.50	0.50	0.50	0.70	0.70	0.70	0.70
Sulfur	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Phosphorous	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.040	0.040	0.040	0.040	0.120	0.120	0.120	0.120	0.120	0.120	0.120
Aluminum	1.50	0.50	0.10	1.00–1.50	1.00–1.50	1.25	0.10	1.25	0.40	1.25	1.25	1.00	1.00	1.00	0.75	0.75	0.75	0.75
Manganese	0.40	0.40	0.40	0.40	0.40	0.50	0.50	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.25	—	1.25	—
Calcium	—	—	—	0.50	0.50	—	—	—	—	—	—	—	—	—	—	—	—	—
Boron	—	—	—	—	—	—	—	—	—	0.04–0.10	0.04–0.10	—	0.04–0.10	0.04–0.10	—	—	0.04–0.10	0.04–0.10

[A] A single value indicates a maximum.
[B] 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 %.

TABLE 2 Standard Sizes and Tolerances

Grades	Standard Sizes	Tolerances and Sieve Sizes Defined by ASTM Specification E 11		Friability Rating[A]
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	
	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	
	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	
	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		
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	
	⅜-in. (9.51-mm) by No. 6 (3.36-mm)	5 %, max, retained on ⅜-in. (9.51-mm) sieve	10 %, max, passing No. 6 (3.36-mm) sieve	
	⅜-in. (9.51-mm) by No. 12 (1.68-mm)	5 %, max, retained on ⅜-in. (9.51-mm) sieve	10 %, max, passing No. 14 (1.41-mm) sieve	
	⅜-in. (9.51-mm) by down	5 %, max, retained on ⅜-in. (9.51-mm) sieve	15 %, max, passing No. 70 (0.21-mm) sieve	
	¼-in. (6.35-mm) by down	5 %, max, retained on ¼-in. (6.35-mm) sieve		
	No. 8 (2.38-mm) by down	5 %, max, retained on No. 8 (2.38-mm) sieve		
	No. 28 (841-ϵm) by down	5 %, max, retained on No. 20 (841-ϵm) sieve		
G	pig	90-lb (40.8-kg) pig, max.		

[A] See Appendixes.

~~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~~

7. Keywords

7.1 ferroalloy; ferrosilicon

1 Chemical Requirements[A]—Steel Making Grades

TABLE 1 *Continued*

Element	Composition, %				
	Grade C[B,C]	Grade D[C]	Grade E[D]	Grade F	Grade G[E]
Silicon	74.0–79.0	65.0–70.0	47.0–51.0	20.0–24.0	14.0–17.0
Carbon, max	0.10	0.10	0.10	0.50	0.70
Sulfur, max	0.025	0.025	0.025	0.025	0.025
Phosphorus, max	0.035	0.035	0.040	0.120	0.120
Aluminum, max	1.50	1.25	1.25	1.00	0.75
Manganese, max	0.40	0.50	0.75	1.00	1.25

[A] For purposes of determining conformance with this specification, the reported analysis

SUPPLEMENTARY REQUIREMENTS

The composition shall be rounded further limited to the nearest unit in the last right-hand place requirements of figures used in expressing the limiting value, in accordance with the rounding method of Recommended Practice E 29.

[B] For low-aluminum grades, aluminum specification is 0.50 %, max.
[C] A high purity grade is available (0.10 max, aluminum).
[D] For low-aluminum grade, aluminum specification is 0.40 %, max.
[E] Manganese content over 1.25 % may be specified as agreed.

TABLE 2 Chemical Requirements[A]—Foundry Grades

Element	Composition, %				
	Grade C 1	Grade C 2	Grade E 1[B,C]	Grade F 1[C]	Grade G 1[C,D]
Silicon	74.0–79.0	74.0–79.0	47.0–51.0	20.0–24.0	14.0–17.0
Carbon, max	0.10	0.10	0.10	0.50	0.70
Sulfur, max	0.025	0.025	0.025	0.025	0.025
Phosphorus, max	0.035	0.035	0.040	0.120	0.120
Aluminum	1.00–1.50	1.00–1.50	1.25 max	1.00 max	0.75 max
Manganese, max	0.40	0.40	0.75	1.00	1.25
Calcium, min	0.50	1.50	...	...	...
Boron	...	...	0.04–0.10	0.04–0.10	0.04–0.10

[A] 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.
[B] Grade E in Table 1 is suitable for foundry use.
[C] Boron content may be specified within a range from 0.04 to 0.10 %. When shipped in 3000-lb containers, the average boron content S1.1. Upon request of a container shall not vary from the average reported for purchaser, the entire shipment by more than 0.010 %.
[D] Manganese content over 1.25 % may be specified as agreed.

TABLE 3 Supplementary Chemical Requirements[A]—Steel Making Grades

Element	Composite, %		
	Grade		
	C	D	E
Chromium, max	0.30	0.50	0.50
Nickel, max	0.10	0.20	0.30
Copper, max	0.10	0.20	0.30
Titanium, max	0.20	0.20	0.20

[A] For purposes of determining conformance with this specification, the reported analysis manufacturer 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[A]—Foundry Grades

Element	Composition, %		
	Grade E 1	Grade F 1	Grade G 1
Chromium, max	0.15	0.25	0.25
Titanium, max	0.20	0.20	0.20

[A] For purposes of determining conformance with this specification, the reported furnish an analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing these elements on a schedule agreed between the limiting value, in accordance with the rounding method of Recommended Practice E 29.

TABLE S1.1 Supplementary Chemical Requirements

Element	Grade																	
	C	CA	CB	C1	C2	D	DA	E	EA	E1	E1A	F	F1	F1A	G	GA	G1	G1A
	Composition, % maximum																	
Chromium 0.30	0.30	0.30	—	—	0.50	0.50	0.50	0.50	0.15	0.15	0.25	0.25	0.25	—	—	0.25	0.25	—
Nickel	0.10	0.10	0.10	—	—	0.20	0.20	0.30	0.30	—	—	—	—	—	—	—	—	—
Copper	0.10	0.10	0.10	—	—	0.20	0.20	0.30	0.30	—	—	—	—	—	—	—	—	—
Titanium	0.20	0.20	0.20	—	—	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	—	—	0.20	0.20

TABLE 5 Standard Sizes manufacturer and Tolerances

Grades	Standard Sizes	Tolerances and Sieve Sizes Defined by ASTM Specification E 11		Friability Rating[A]
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	
	4-in. (102-mm) by down	10 %, max, retained on 4-in. (102-mm) sieve	12 %, max, passing purchaser. 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 Grade C-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 D-4 Grade E-5
	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	
	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 Grade B-4
	⅜-in. (9.51-mm) by No. 6 (3.36-mm)	5 %, max, retained on ⅜-in. (9.51-mm) sieve	10 %, max, passing No. 6 (3.36-mm) sieve	Grade C-4 Grade D-4
	⅜-in. (9.51-mm) by No. 12 (1.68-mm)	5 %, max, retained on ⅜-in. (9.51-mm) sieve	10 %, max, passing No. 14 (1.41-mm) sieve	Grade E-5
	⅜-in. (9.51-mm) by down	5 %, max, retained on ⅜-in. (9.51-mm) sieve	15 %, max, passing No. 70 (0.21-mm) sieve	
	¼-in. (6.35-mm) by down	5 %, max, retained on ¼-in. (6.35-mm) sieve		
	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

[A] 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, %
A	92.0–95.0 Si
B	82.0–88.0 Si
B-1	83.0–88.0 Si, 0.5 Ca
B-2	83.0–88.0 Si, 1.5 Ca
C74.0–79.0 Si	4
C	4
C-1	74.0–79.0 Si, 0.5 Ca
C-2	74.0–79.0 Si, 1.5 Ca
D65.0–70.0 Si	4
D	4
E47.0–51.0 Si	5
E	5
E-1	47.0–51.0 Si, 0.04–0.10 B
F20.0–24.0 Si	4
F	4
F-1	20.0–24.0 Si, 0.04–0.10 B
G14.0–17.0 Si	2 G-1
G	2 G-1

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).
2	Some breakage
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).
4	Appreciable reduction in size of large pieces upon repeated handling. Some fines produced upon repeated handling of crushed sizes. (Example: selected changes to this standard ferromanganese).

SUMMARY OF CHANGES

Committee A01 has identified the location of large pieces probable in shipping and handling. No appreciable fines produced from either lump or crushed sizes. (Example: chrom

TABLE X1.2 *Continued*

Code No.	Definition
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).
5	Appreciable reduction in size in repeated handling of large pieces. Appreciable fines since the last issue (A 100 – 93 (2000)) that may impact the use of crushed sizes. (Example: 50 % ferrosilicon).
6	This category represents the most friable alloys. (Example: calcium silicon).

this standard.

(1) Revised 1.1, 3, 4.1, 5, and 6.

(2) Added A1025 to 2.

(3) Removed sections on Sampling, Inspection, Rejection, and Packaging.

(4) Added keywords.

(5) Added Supplementary Requirements section.

(6) Added Appendix X1.

(7) Removed original Tables 1 through 3 and replaced with new Tables 1 and 2.