

STEEL FOUNDERS' SOCIETY OF AMERICA

Standard Specification for
MALLEABLE IRON ABRASIVES

SFSA Designation: 2 I-68

ISSUED: 1968

Superseding 21T-66, Issued 1966. Advanced to Standard Specification without Change.

1. Scope

1.1 This specification covers all malleable iron abrasives (shot and grit) which are used for blast cleaning steel castings.

2. Acknowledgment

2.1 When specified, a vendor shall indicate this specification number in all quotations, and when acknowledging purchase orders.

TABLE I-MALLEABLE IRON SHOT

Screen opening sizes and screen *numbers* with maximum *and minimum cumulative percentages allowed* on *corresponding* screens. *The dash lines "—" listed in the Table mean that the corresponding screen is not to be included in the screening test.*

Screen No.	Screen Size	SHOT NUMBER								
		780	660	550	460	390	330	280	230	170
7	0.1110	1% Max.	—	—	—	—	—	—	—	—
8	0.0937	—	1% Max.	—	—	—	—	—	—	—
10	0.0787	85% Min.	—	1% Max.	1% Max.	—	—	—	—	—
12	0.0661	97% Min.	85% Min.	—	5% Max.	1% Max.	—	—	—	—
14	0.0555	—	97% Min.	85% Min.	—	5% Max.	1% Max.	—	—	—
16	0.0469	—	—	97% Min.	85% Min.	—	5% Max.	1% Max.	—	—
18	0.0394	—	—	—	96% Min.	85% Min.	—	5% Max.	1% Max.	—
20	0.0331	—	—	—	—	96% Min.	85% Min.	—	10% Max.	1% Max.
25	0.0280	—	—	—	—	—	96% Min.	85% Min.	—	10% Max.
30	0.0232	—	—	—	—	—	—	96% Min.	85% Min.	—
35	0.0197	—	—	—	—	—	—	—	97% Min.	—
40	0.0165	—	—	—	—	—	—	—	—	85% Min.
45	0.0138	—	—	—	—	—	—	—	—	97% Min.
50	0.0117	—	—	—	—	—	—	—	—	—

TABLE II-MALLEABLE IRON GRIT

Screen opening sizes and screen numbers with minimum cumulative Percentages allowed on corresponding screens, except where 1 percent maximum is indicated. The dash lines "—" listed in the Table mean that the corresponding screen is not to be included in the screening test.

Screen No.	Screen Size	GRIT NUMBER								
		G-10	G-12	G14	G-16	G-18	G-25	G-40	G-50	
7	0.1110			1% Max.	—	—	—	—	—	—
8	0.0937	—	1% Max.	—	—	—	—	—	—	—
10	0.0787	80%	—	1% Max.	—	—	—	—	—	—
12	0.0661	90%	80%	—	1% Max.	—	—	—	—	—
14	0.0555	—	90%	80%	—	1% Max.	—	—	—	—
16	0.0469	—	—	90%	75%	—	1%	Max.	—	—
18	0.0394	—	—	—	85%	75%	—	1% Max.	—	—
20	0.0331	—	—	—	—	—	—	—	—	—
25	0.0280	—	—	—	—	85%	70%	—	1% Max.	—
30	0.0232	—	—	—	—	—	—	—	—	—
35	0.0197	—	—	—	—	—	—	—	—	—
40	0.0165	—	—	—	—	—	80%	70%	—	—
45	0.0138	—	—	—	—	—	—	—	—	—
50	0.0117	—	—	—	—	—	—	80%	65%	—
80	0.0070	—	—	—	—	—	—	—	—	75%

3. Identification

3.1 All malleable iron shot shall be identified by the letter "S-Malleable" or producers' Trade name. This designation shall be followed by a suffix number which corresponds to the aperture size of the nominal screen.

3.2 All malleable iron grit shall be identified by the letter "G-Malleable" followed by the suffix number which corresponds to the mesh number of the nominal screen.

4. Technical Requirements

4.1 Composition

4.1.1 The chemical composition shall conform to the following limitations:

Carbon (total)	2.40 - 3.40 percent
Silicon	1.00 - 1.70 percent
Phosphorus	0.30 (max) percent
Sulfur	0.20 (max) percent

4.2 Screen Analyses

4.2.1 Screen analyses shall be made on a minimum 100-gram sample of the abrasive. The sizes of the

screens shall be in accordance with the National Bureau of Standards' series as given ASTM E-1 I.

4.2.2 The classification for malleable iron S-Malleable 170, S-Malleable 230, S-Malleable 280, S-Malleable 330, S-Malleable 390, S-Malleable 460, S-Malleable 550, S-Malleable 660, and S-Malleable 780 shot shall be according to the limits listed in Table I.

4.2.3 The classification for malleable iron grit G-Malleable 10, G-Malleable 12, G-Malleable 14, G-Malleable 16 G-Malleable 18, G-Malleable 25, G-Malleable 40, and G-Malleable 50 shall be according to the limits listed in Table II.

4.3 Hardness

4.3.1 The average hardness of 20 particles of abrasives determined at half radius, shall fall within the limits of 28 to 40 **R_C**

4.3.2 A minimum of 15 readings (75 percent) shall fall within the limits of **28** to 40 **R_C**

4.4 Microstructure

4.4.1 Abrasives containing free graphite must have

the graphite in the form of small rosettes of temper carbon.

4.4.2 Abrasives having microstructures, similar to those illustrated in Figures 1 thru to 4, are unsatisfactory.

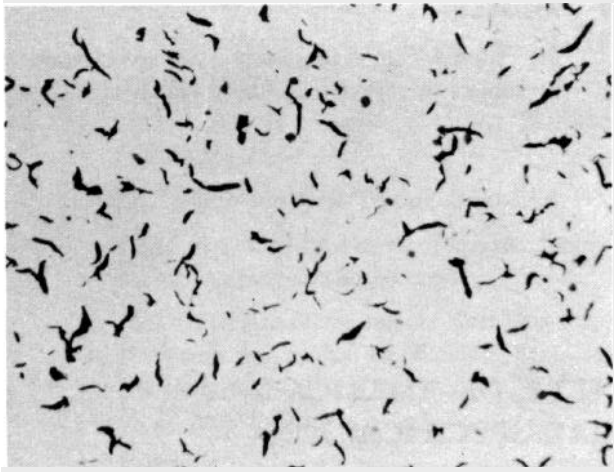
4.4.3 The abrasive shipment is also subject to rejection if over 15 percent of the particles have microstructures typified by photomicrographs illustrated in Figures 1, 2, 3, and 4.

4.5 Objectionable Defects

4.5.1 Voids

4.5.1.1 Malleable iron abrasive particles in a representative mounted sample shall not contain voids, as illustrated in Figure 5, in excess of 10 percent as determined at a magnification of 10X.

4.5.1.2 A void must be greater than 10 percent of the area of the particle to be considered harmful.



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Figure 1-Primary graphite in the form of irregularly shaped flakes. If any portion of the field shows flake graphite, it is an unacceptable microstructure. (500X)

4.5.2 Shrinkage

4.5.2.1 Malleable iron abrasive particles in a representative mounted sample shall not contain shrinkage, as illustrated in Figure 6, in excess of 10 percent as determined at a magnification of 10X.

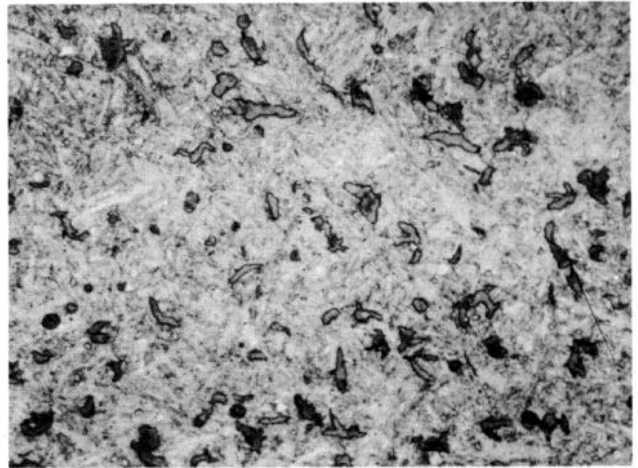
4.5.2.2 A shrinkage area must be greater than 10 percent of the area of the particle to be considered harmful.

4.5.3 Cracks

4.5.3.1 The malleable iron abrasive particles in a representative mounted sample shall not contain cracked particles in excess of 15 percent as determined at a magnification of 10X.

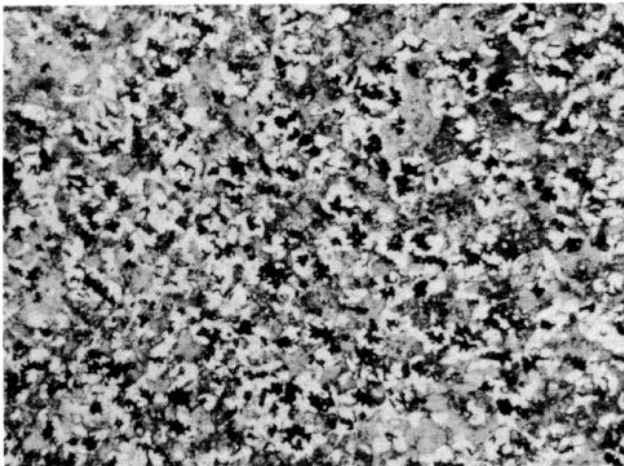
4.5.4 Particle Shape

4.5.4.1 The malleable iron shot abrasive particles in a representative mounted sample shall not contain



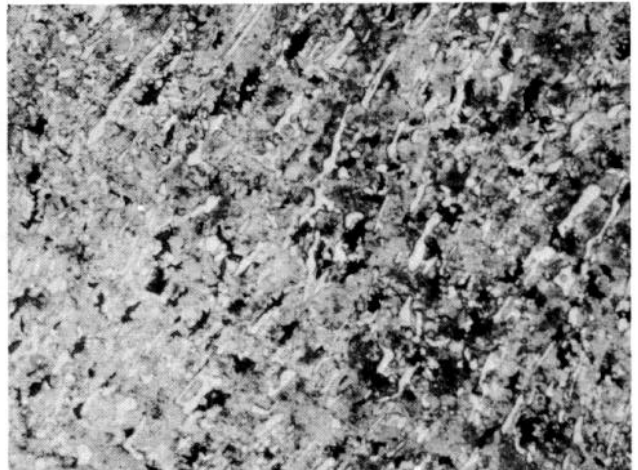
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Figure 2-Graphite particles in a matrix of slightly tempered martensite and retained austenite. The light area is untransformed austenite which on impact will transform to hard brittle untempered martensite. (500X)



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Figure 3-Tempered carbon in slightly tempered martensite together with a large amount of ferrite. (500X)



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Figure 4-Stringers of massive iron carbide (white). (500X)

elongated particles in excess of 5 percent as determined at a magnification of 4X.

4.5.4.2 An elongated particle is one in which the length is greater than twice the cross section as illustrated in Figure 7.

5. Sample Preparation

5.1 The number of abrasive unit packages to be sampled by the consumer for routine check of the technical requirements shall be a minimum of 3 taken at random from each 2000-pound shipment.

5.1.1 A 5-pound grab sample shall be taken from each of the package units.

5.1.1.1 One hundred-gram samples shall be taken from each 5-pound grab sample for testing purposes.

5.1.2 A sample instrument may be used to take the samples which shall then be combined, mixed and quartered to obtain a 5-pound laboratory sample.

5.2 The number of samples for umpire check shall be according to ASTM C322-53T, procedure C.

5.2.1 The number of samples shall depend on the number of units in a shipment. The samples shall be combined, mixed and quartered or riffled to obtain a 5 -pound (approximately 2 2 70 grams) laboratory sample.

5.2.2 Where a shipment consists of 100 unit packages or less, the number of units sampled at random shall be not less than 5, and preferably 10. When the number is greater than 100 but less than 500, the number of units to be sampled shall be not less than 15. For lots of from 500 to 1000 units, 20 units shall be sampled. For shipments of 1000 to 2000 units, 30 units shall be sampled at random.

5.3 An alternate method of reducing the gross sample

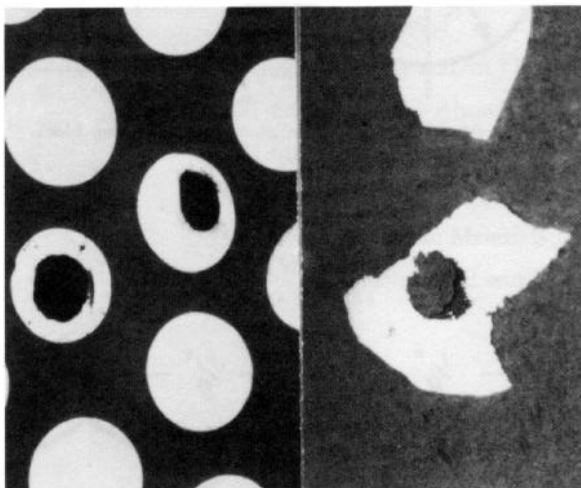


Figure 5-Illustration of void in shot (left) and grit particles (right).

is by the use of a sample splitter such as described in the AFS Foundry Sand Handbook (Seventh Edition), Sec. III.

6. Mounting Abrasive Particles

6.1 A minimum of 100 abrasive particles shall be mounted in plastic.

6.2 Mounting the abrasive particles in rows, facilitates determining percentages with objectional defects. This may be done in one of several ways.

6.2.1 Metal strips may be used to orient the particles in rows.

6.2.2 Particles may be mounted in rows by using a grooved pad in the mounting press.

6.2.2.1 The bottom block for mounting and the machining details of the grooves are illustrated in Figures 8 and 9, respectively.

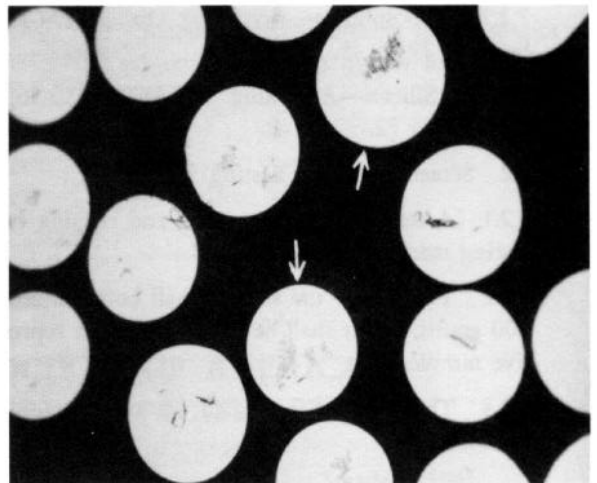


Figure 6-Illustration of shrinkage in malleable iron abrasive particle. (10X)

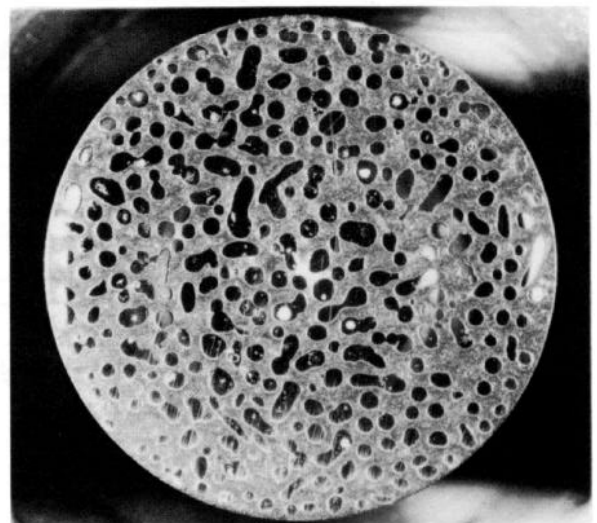


Figure 7-Illustration of elongated abrasive shot particles. (4X)

6.2.3 The abrasive particles may be mounted in a "V" grooved mounting base which can be used for all sizes of shot.

6.2.3.1 The dimensions of the "V" grooves are shown in Figure 10.

6.3 Grind the particles to the center.

7. Acceptance Tests

7.1 Chemical Composition.

7.1.1 Routine analyses may be made by spectrographic methods or by wet chemical methods.

7.1.2 Referee methods shall be based on ASTM-E30-56.

7.1.2.1 Carbon-According to ASTM-E30-56, Sections 5 to 12.

7.1.2.2 Sulfur-According to ASTM-E30-56, Sections 46 to 57 and 155 to 157.

7.1.2.3 Phosphorus-According to ASTM-E30-56, Sections 29 to 45.

7.1.2.4 Silicon-According to ASTM-E30-56, Sections 61 to 72.

7.2 Screen Analysis Testing Procedure.

7.2.1 A standard make rotating and tapping type of testing machine should be used.

7.2.2 The size of the sample shall be a minimum of 100 grams, and it shall be obtained from a representative sample.

7.2.3 The time of test shall be a minimum of 5 minutes.

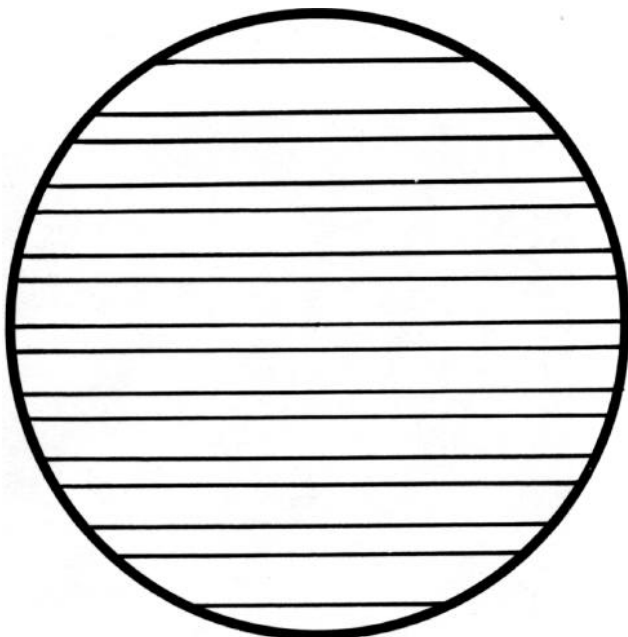


Figure S-Bottom block for mounting press.

7.2.4 In performing the screen test, only the screens indicated in either Tables I or II shall be used, e.g., in screening a 550 malleable iron shot, only screens Nos. 10, 14 and 16 together with a pan will be used.

7.3 Test Procedure for Hardness Test Data.

7.3.1 A minimum of 20 hardness readings shall be taken at random at half radius with a microhardness tester. (See Note 1.)

7.3.1.1 If the hardness readings do not meet the limitation set forth in 4.3, another set of 20 readings from the same mounted specimen or from another mounted specimen is permitted.

NOTE 1.-The hardness may be determined by any of the various methods applicable to small sections, such as a Tukon Tester with Vickers indenter at loads determined to provide a reliable conversion to Rockwell C.

The Rockwell Superficial-Hardness Tester using the 15N scale is not considered satisfactory because the supporting material in the mount will deflect under the applied load, and when the load is removed, the material will not return to its original position. Therefore, the deflection or movement is recorded on the dial gauge, which results in an inaccurate reading.

7.4 Microstructure

7.4.1 The plastic mount of the abrasive particles used in the hardness survey may be used by repolishing and etching.

7.4.2 The etched sample of the abrasive particles shall be examined at 500X and compared with the photomicrographs in Section 4.4.

7.5 Test Methods for Determining the Extent of Defects in Abrasive Particles.

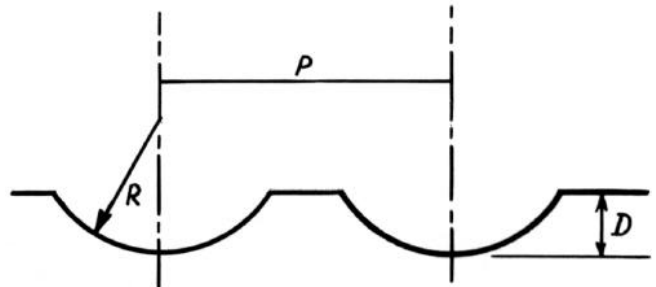


Figure Y-Machining details for grooves in mounting block.

N = Particle Diam.

$P = 1.5N$

$R = 0.7N$

$D = 0.4N$

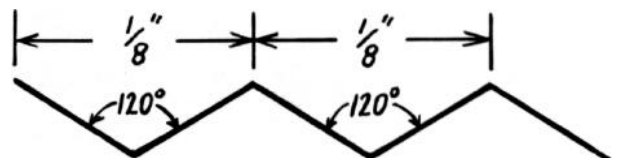


Figure I O-Dimensions for "V" grooves.

7.5.1 Voids

7.5.1.1 A representative sample of a minimum of 100 abrasive particles shall be mounted, ground and polished as detailed in 6.

7.5.1.2 Determine at a magnification of 10X the percentage of abrasive particles (min. 100) in the plastic mount or mounts which contain voids as defined in 4.5.1.2.

7.5.2 Shrinkage.

7.5.2.1 Determine at a magnification of 10X the percentage of abrasive particles (min. 100) in the plastic mount or mounts which contain shrinkage as defined in 4.5.2.1.

7.5.3 Cracks

7.5.3.1 Determine at a magnification of 10X the percentage of abrasive particles (min. 100) in the plastic mount or mounts which contain cracks as defined by 4.5.3.1.

7.5.4 Particle Shape

7.5.4.1 Determine at a magnification of 4X the percentage of abrasive particles (min. 100) on the plastic mount or mounts which contained elongated particles as defined by 4.5.4.2.

a. Packaging

8.1 Packaging shall be accomplished in such a manner as to insure that the abrasives are not exposed to moisture and are protected against loss.

8.2 Each container shall be legibly marked with the following information:

8.2.1 Name of abrasive.

8.2.2 Quantity or weight.

8.2.3 Size and type designation.

8.2.4 Manufacturer's name.

9. Rejection

9.1 Material not conforming to the specification will be subject to rejection by the foundry.