

STEEL FOUNDERS' SOCIETY OF AMERICA

*Standard Specification for*  
**CAST STEEL ABRASIVES**

Reprinted: 1980

**SFSA Designation: 20-66**

This Standard Specification has been approved by the Society's Specifications Committee. Tentative Specification 20T-66 has been advanced to Standard Specification 20-66 without change. Comments on this Specification should be addressed to the Steel Founders' Society at Cast Metals Federation Building, 20611 Center Ridge Road, Rocky River, Ohio 44116

**1. Scope**

1.1 This specification covers all cast steel abrasives for general steel foundry usage in the blast cleaning of 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—CAST STEEL 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—CAST STEEL 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	G-14	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 cast steel abrasives shall be identified by the letters "S-Steel." This designation shall be followed by a suffix number which corresponds with the aperture size of the nominal screen.

3.2 All cast steel grit abrasives shall be identified by the letters "G-Steel." This designation shall be followed by a suffix number which corresponds with the aperture size of the nominal screen.

**4. Technical Requirements**

**4.1 Composition.**

4.1.1 The chemical composition shall conform to the following limitations:

Carbon	0.75 - 1.20 percent
Silicon	0.40 - 1.50 percent
Sulfur	0.05 percent (max.)
Phosphorus	0.05 percent (max.)

Alloy additions are optional. If used, chemical ranges must be supplied.

**4.2 Screen Analyses.**

4.2.1 Screen analyses shall be made on a minimum 100-gram sample of the abrasive. The size of the screens shall be in accordance with the National Bureau of Standards' series as given in ASTM E-11.

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

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

**4.3 Hardness Values.**

4.3.1 The average hardness of 20 particles of abrasive, determined at half radius, shall fall within the limits of 40 to 50 Rc.

4.3.2 A minimum of 17 readings shall fall within the limits of 40 to 50 Rc.

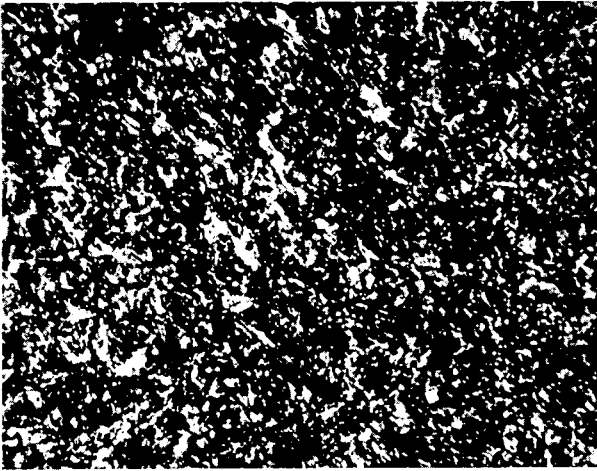
**4.4 Microstructure.**

4.4.1 The microstructure of the abrasive shall consist of martensite, tempered to a degree consistent with the hardness range.

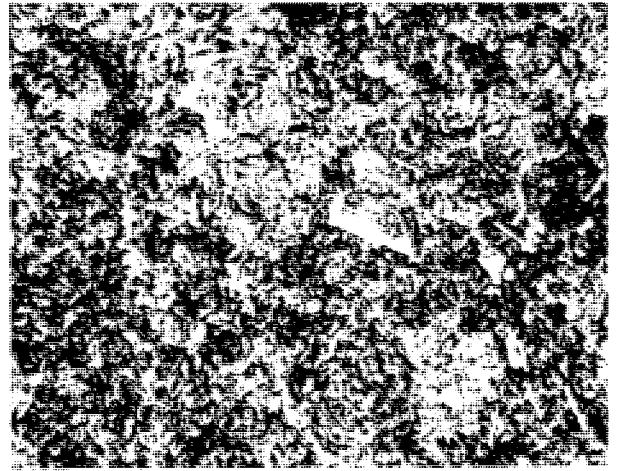
4.4.2 The presence of free ferrite or free graphite is unsatisfactory.

4.4.3 Figures 1 and 2 are examples of satisfactory microstructures.

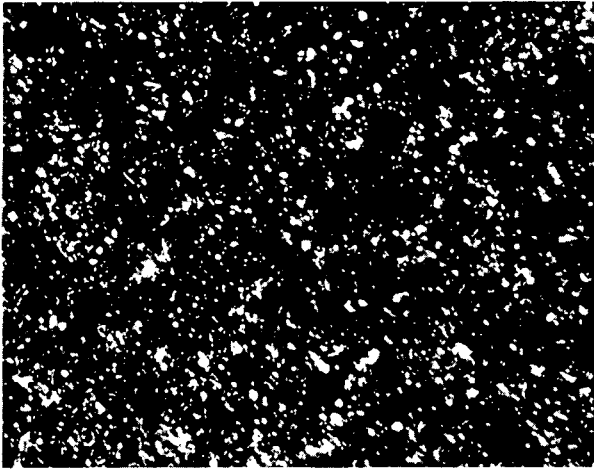
4.4.4 Abrasives having microstructures similar to those illustrated in Figures 3, 4, 5 and 6 are unsatisfactory.



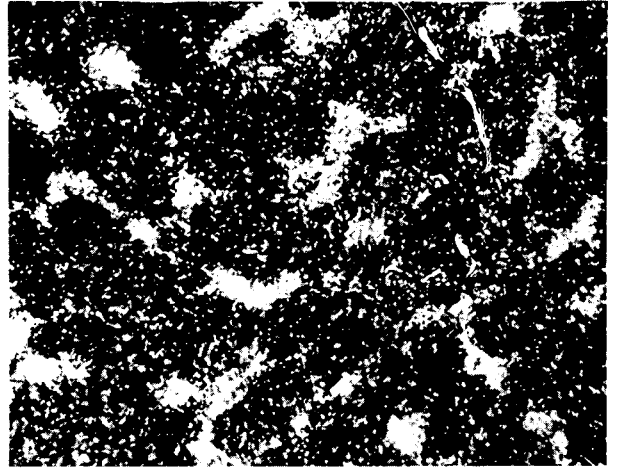
SATISFACTORY  
Figure 1—Tempered martensite. (500X)



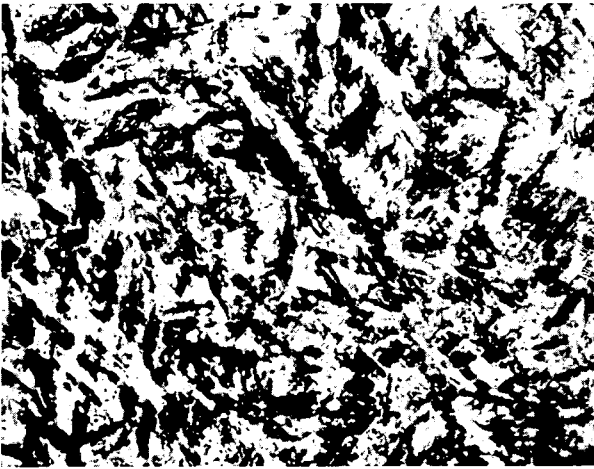
SATISFACTORY  
Figure 2—Uniformly tempered martensite and bainite. (500X)



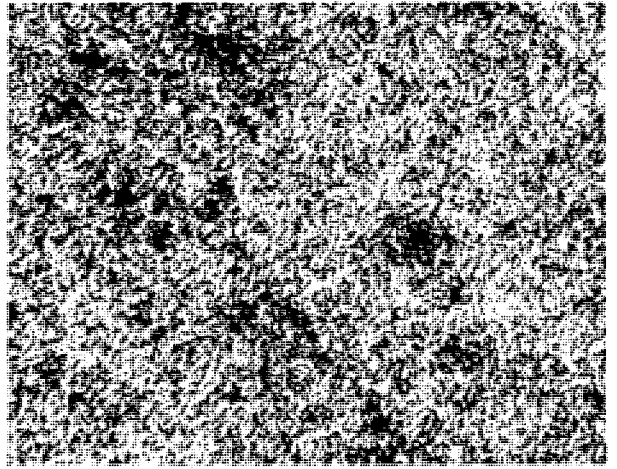
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Figure 3—Tempered martensite and numerous excess carbides. (500X)



UNSATISFACTORY  
Figure 4—Tempered martensite and bainite segregated at the grain boundaries. (500X)



UNSATISFACTORY  
Figure 5—Martensite only slightly tempered. Retained austenite only partially transformed. (500X)



UNSATISFACTORY  
Figure 6—Spheroids of cementite in a matrix of ferrite. (500X)

## 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 abrasive particles in rows as illustrated in Figure 9.

6.2.2 The abrasive 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 12 and 13.

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 14.

6.3 Grind the abrasive particles to the center.

## 7. Acceptance Tests

7.1 Chemical Composition.

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

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

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

7.1.4 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.

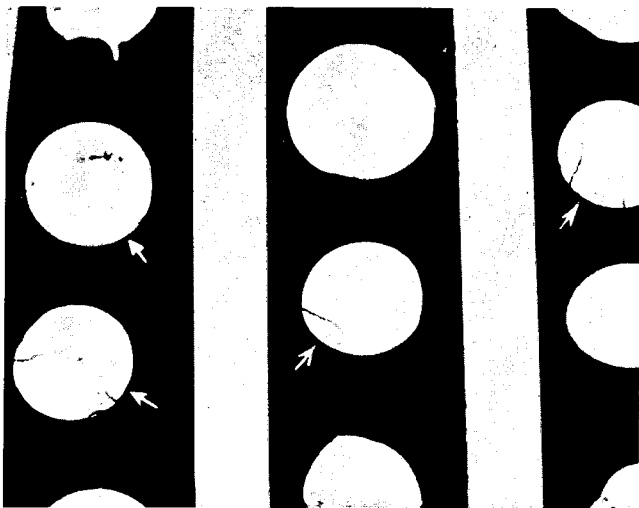


Figure 9—Abrasive particles with cracks greater in length than 20 percent of the diameter. (10X)

7.2.4 In performing the screen test, only the screens indicated in Table 1 shall be used, e.g., in screening a 550 abrasive, 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 micro-hardness tester. See Note 1.

7.3.1.2 If the hardness readings do not meet the limitation set forth in 4.3, another set of 20 readings from the same specimen or from another 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 mounts 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 gage which results in an inaccurate reading.

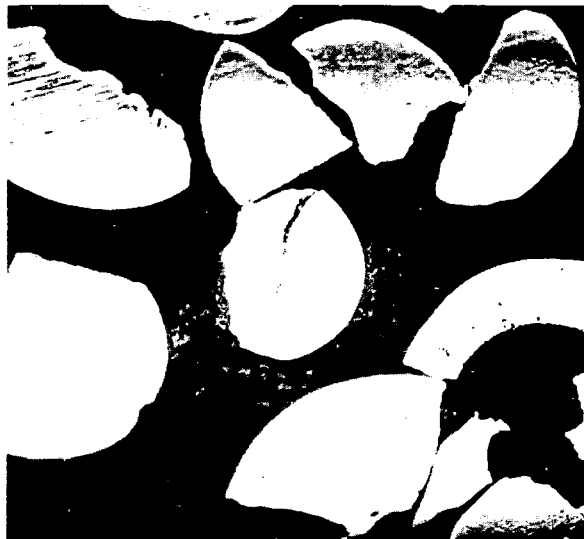


Figure 10—Abrasive steel grit particle with objectionable crack. (10X)

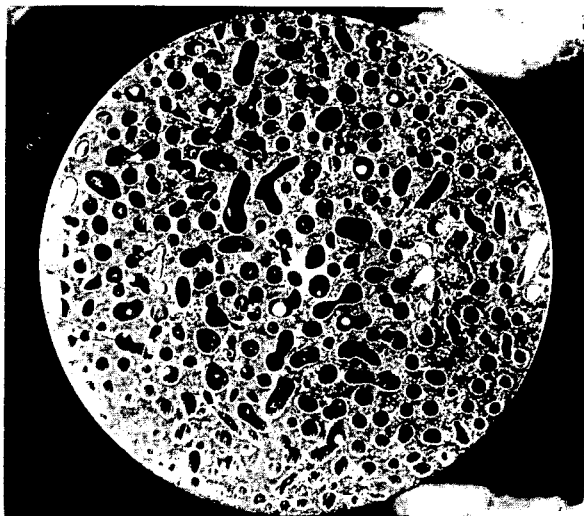


Figure 11—Photograph of mounted specimen of abrasive shot particles exhibiting greater than 5 percent elongated particles. (4X)

4.4.4.1 The abrasive shipment is subject to rejection if over 15 percent of the abrasive particles have microstructures typified by photomicrographs illustrated in Figures 3, 4, 5, and 6.

4.4.4.2 The abrasive is also subject to rejection if over 15 percent of the abrasive particles have microstructures showing either free graphite (flake) or free ferrite.

#### 4.5 Objectionable Defects.

##### 4.5.1 Voids.

4.5.1.1 Cast steel abrasive particles in a representative mounted sample shall not contain voids, as illustrated in Figure 7, 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 abrasive particle to be considered harmful and counted as a void.

##### 4.5.2 Shrinkage.

4.5.2.1 Cast steel abrasive particles in a representative mounted sample shall not contain shrinkage as illustrated in Figure 8 in excess of 10 percent as determined at a magnification of 10X.

4.5.2.2 A shrinkage area must be greater than 40 percent of the area of the abrasive particle to be considered harmful.

##### 4.5.3 Cracks.

4.5.3.1 A crack is a linear discontinuity whose length is greater than 3 times its width and its length is greater than 20 percent of the diameter or the shortest dimension of the abrasive particle.

4.5.3.2 Cast steel shot abrasive particles in a representative mounted sample shall not contain cracked particles as illustrated in Figure 9 in excess of 15 percent as determined at a magnification of 10X.

4.5.3.3 Cast steel grit abrasive particles in a representative mounted sample shall not contain cracked particles as illustrated in Figure 10 in excess of 40 percent as determined at a magnification of 10X.

##### 4.5.4 Particle Shape of Shot.

4.5.4.1 The cast steel shot abrasive particles in a representative mounted sample shall not contain elongated particles in excess of 5 percent as determined at 4X magnification.

4.5.4.2 An elongated particle is one in which the length is in excess of twice the cross section, as illustrated in Figure 11.

## 5. Sample Preparation

5.1 The number of abrasive package units 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 pounds of each shipment.

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

5.1.1.1 A 100-gram sample shall be taken from each 5-pound grab sample for testing purposes.

5.1.2 A sampling 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 2270 grams) laboratory sample.

5.2.2 Where a shipment consists of 100 package units or less, the number of package units sampled at random shall be not less than 5 and preferably 10.

5.2.3 When the number is greater than 100, but less than 500, the number of units to be sampled shall not be 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 for reducing the gross sample is by the use of a sample splitter, such as described in the AFS "Foundry Sand Handbook." (Seventh Edition), Sec. III.

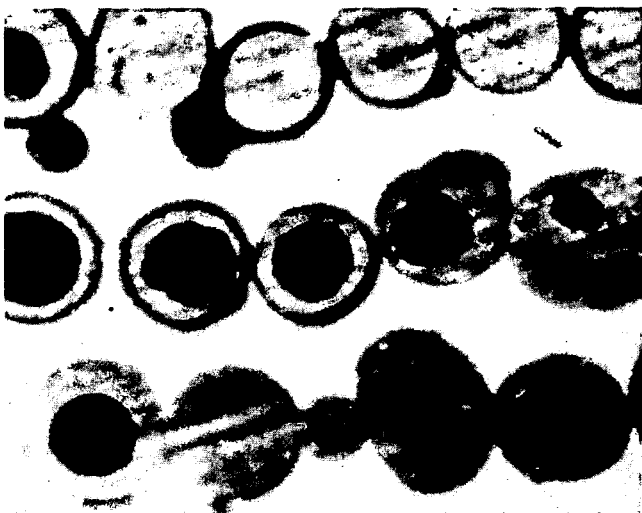


Figure 7—Cast steel shot particles with voids greater than 10 percent of the area of the abrasive particle. (10X)

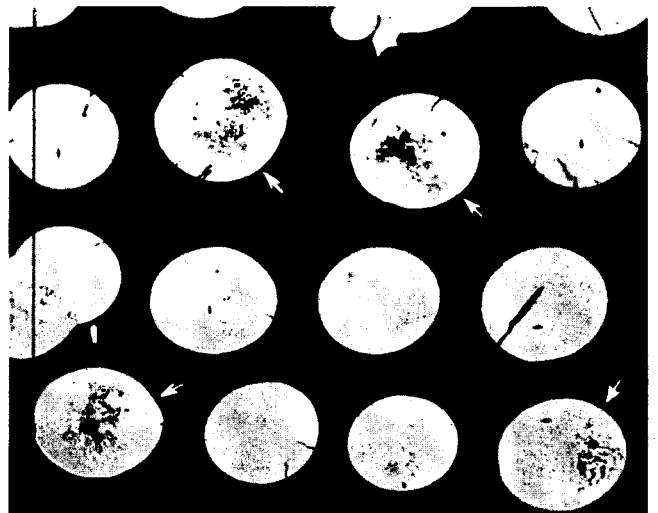


Figure 8—Abrasive particles with shrinkage in excess of 40 percent of area of particle. (10X)

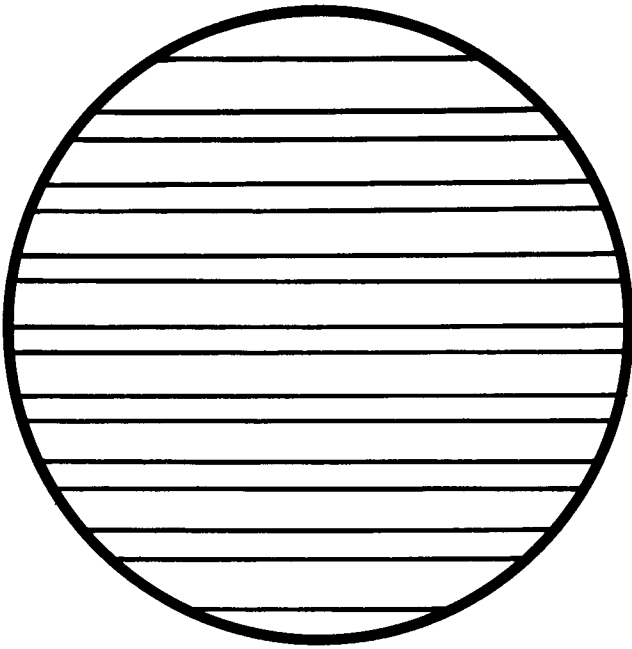


Figure 12—Bottom block for mounting press.

#### 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.

##### 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 by 4.5.2.2.

##### 7.5.3 Cracks.

7.5.3.1 Determine at a magnification of 10X the

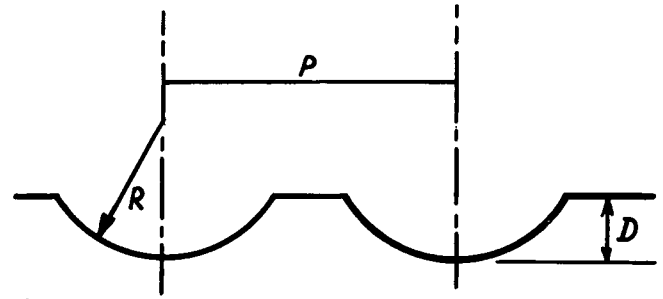


Figure 13—Machining details for grooves in mounting block.

$N = \text{Particle Diam.}$

$P = 1.5N$

$R = 0.7N$

$D = 0.4N$

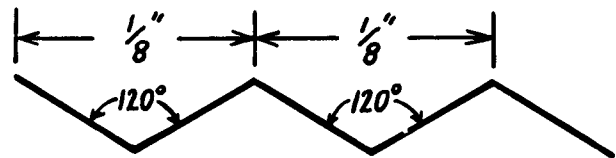


Figure 14—Dimensions for "V" grooves.

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) in the plastic mount or mounts which contain elongated particles as defined by 4.5.4.2.

## 8. Packaging

8.1 Packaging shall be accomplished in such 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 subjected to rejection by the foundry.