U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
(formerly National Bureau of Standards-NBS)

Product Standard (PS) 8-67
Grading of Abrasive Grain on Coated Abrasive Products

Product Standard PS8-67 (supersedes Commercial Standard CS217-59), Grading of Abrasive Grain on Coated Abrasive Products, was withdrawn by the U.S. Department of Commerce on July 25, 1977.

The following standard was used to replace PS8-66: ANSI Standard B74.18, Specification for Grading of Certain Abrasive Grain on Coated Abrasive Products.

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The Unified Abrasives Manufacturers' Association was formed in 1999 from the merging of four predecessor organizations: the Abrasive Grain Association, Coated Abrasives Manufacturers' Institute, Diamond Wheel Manufacturers' Institute and the Grinding Wheel Institute.

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PRODUCT STANDARD PS8-67

Supersedes Commercial Standard CS217–59

Grading of Abrasive Grain on Coated Abrasive Products

A RECORDED VOLUNTARY STANDARD OF THE TRADE

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

federal register

DEPARTMENT OF COMMERCE

National Bureau of Standards

GRADING OF ABRASIVE GRAIN ON COATED ABRASIVE PRODUCTS

Voluntary Product Standard Action on Proposed Withdrawal

In accordance with § 10.12 of the Department's "Procedures for the Development of Voluntary Product Standards" (15 CFR Part 10), notice is hereby given of the withdrawal of Voluntary Product Standard PS 8–67, "Grading of Abrasive Grain on Coated Abrasive Products."

It has been determined that this standard is technically inadequate and that revision would serve no useful purpose. The subject matter of PS 8–67 is adequately covered by the American National Standards Institute's standard ANSI B74.18, "Specification for Grading of Certain Abrasive Grain on Coated Abrasive Products." This action is taken in furtherance of the Department's announced intentions as set forth in the public notice appearing in the FEDERAL REGISTER of April 12, 1977 (42 FR 19169) to withdraw this standard.

The effective date for the withdrawal of this standard will be July 25, 1977. This withdrawal action terminates the authority to refer to the standard as a voluntary standard developed under the Department of Commerce procedures.

Dated: May 23, 1977.

ERNEST AMBLER,
Acting Director.

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U.S. DEPARTMENT OF COMMERCE

John T. Connor, Secretary

NATIONAL BUREAU OF STANDARDS

A. V. Astin, Director

Office of Engineering Standards Services

EFFECTIVE DATE

Having been passed through the regular procedures of the Office of Commodity Standards (now the Office of Engineering Standards Services, National Bureau of Standards) and approved by the acceptors hereinafter listed, this Product Standard is issued by the National Bureau of Standards, effective January 9, 1967.

A. V. ASTIN, *Director*

PRODUCT STANDARDS

Product Standards are developed by manufacturers, distributors, and users in cooperation with the Office of Engineering Standards Services of the National Bureau of Standards. The purpose of a Product Standard may be either (1) to establish standards of practice for sizes, dimensions, varieties, or other characteristics of specific products; or (2) to establish quality criteria, standard methods of testing, rating, and labeling of manufactured products.

The adoption and use of a Product Standard is voluntary. However, when reference to a Product Standard is made in contracts, labels, invoices, or advertising literature, the provisions of the standard are enforceable through usual legal channels as a part of the sales contract.

Product Standards usually originate with the proponent industry. The sponsors may be manufacturers, distributors, or users of the specific product. One of these three elements of industry submits to the Office of Engineering Standards Services, the necessary data to be used as a basis for developing a standard of practice. The Office, by means of assembled conferences or letter referenda, or both, assists the sponsor group in arriving at a tentative standard of practice and thereafter refers it to the other elements of the same industry for approval or for constructive criticism that will be helpful in making any necessary adjustments. The regular procedure of the Office assures continuous servicing of each product Standard through review and revision whenever, in the opinion of the industry, changing conditions warrant such action.

The initial printing of PS8–67 was made possible through the cooperation of the Coated Abrasives Manufacturers' Institute.

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Product Standard PS8-67
Superseding Commercial Standard CS217-59

Grading of Abrasive Grain on Coated Abrasive Products

(Effective January 9, 1967)

CONTENTS

1. PURPOSE

1.1 The purpose of this Product Standard is to provide a nationally recognized standard for grading by particle size the abrasive grain on coated abrasive products such as sheets, belts, bands, and disks. It provides uniform methods for recovering the grain from the coated product, and for testing the recovered grain to determine conformity with the grading limits of this Standard. The standard also serves as a basis for understanding between purchasers and sellers as to the particle size desired or supplied, and provides a uniform method of declaring conformance of the product with the grit size designated.

2. SCOPE

2.1 The scope of this Product Standard is confined to a determination of the grit sizes of the abrasive grain on the coated product. However, the information may also be of use in the preparation of abrasive grain for making coated abrasive products. It has been developed to cover, insofar as possible, the

grading of the grit sizes of abrasive grain on the standard coated abrasive products listed in Simplified Practice Recommendation R89[1]. However, in the case of certain coated abrasive products grading practices vary from one manufacturer to another and consideration of the information given herein under "Exceptions" (see 3.1.2) is necessary for the correct interpretation of this Product Standard.

3. CLASSIFICATION AND DEFINITIONS

3.1 **Classification.**—Coated abrasive grit sizes fall into two general classifications, screen grit sizes and sedimentation grit sizes. Those which are coarse enough to be measured and controlled by the use of sieves are called "screen grit sizes", whereas those which are so fine that they have to be measured and controlled by a sedimentation method based on Stokes Law are called "sedimentation grit sizes". The term "screen grit sizes" is used because of well established industry practice, but the particle size distribution is actually controlled by means of sieves.

3.1.1 **Kinds of abrasive grain and grit sizes.**—This Product Standard covers the grit sizes of several kinds of abrasive grain as indicated in Table 1.

TABLE 1. *Classification of abrasive grain for coated abrasive products*

Screen grit sizes	
Kind of abrasive grain	Grit sizes
Aluminum oxide	6/0–220 and coarser
Silicon carbide	6/0–220 and coarser
Garnet	6/0–220 and coarser
Emery	Fine through extra coarse
Flint (finishing paper)	4/0, 3/0, and 2/0
Flint (paper)	Extra fine through extra coarse
Flint (roll paper)	Extra fine through coarse
Flint (pouncing paper)	220 and 150
Flint (snuffing paper)	220 and 180
Sedimentation grit sizes	
Kind of abrasive grain	Grit sizes
Aluminum oxide	7/0–240 and finer
Silicon carbide	7/0–240 and finer
Garnet	7/0–240 and finer
Flint (finishing paper)	7/0, 6/0, and 5/0
Flint (pouncing paper)	400, 360, 320, 280, and 240
Flint (snuffing paper)	400, 320, 280, and 240

3.1.2 **Exceptions.**

3.1.2.1 **Emery polishing paper.**—Emery polishing paper, which is sometimes called French Emery Paper, is not graded according to the standards shown for Emery, and should not be confused with Emery Paper Sheets, C Backing, as listed in R89.

3.1.2.2. **Crocus cloth.**—Crocus cloth is a coated abrasive product which has an abrasive grain coating consisting essentially of ferric oxide. Abrasive grain size shall be as specified in Federal

[1] Copies of Simplified Practice Recommendation R89–55, Coated Abrasive Products, or latest issue, may be obtained from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Specification P–C–458 [2] which is as follows:

All through ..... U. S. Standard Sieve No. 140
Not more than 20% on ..... U. S. Standard Sieve No. 325

3.2 **Definitions.**—The trade terms used herein and their definitions are as follows:

Coarseness of total grit size.—That portion of the abrasive grain by weight (consisting substantially of the entire sample) which passes through the coarse sieves.

Overgrade.—That portion of the abrasive grain by weight which remains on the control sieve.

Control.—That portion of the abrasive grain by weight which passes through the control sieve but remains on the fines sieve.

Fines.—That portion of the abrasive grain by weight which passes through the fines sieve.

4. GRADING LIMITS (REQUIREMENTS)

4.1 **Screen grit sizes.**—The determination of the particle size distribution of an abrasive grain classified as a screen grit size abrasive shall always be considered with reference to its standard sand as determined by testing both the abrasive grain from the coated sheet and the standard sand with the same sieves [3] according to the procedures described in section 6 herein. The abrasive grain shall be recovered from the coated product as described in Section 5. The recovered abrasive grain shall meet the grading limits specified in 4.1.1 or 4.1.2 as applicable.

4.1.1 **Aluminum oxide, garnet and silicon carbide.**

4.1.1.1 **Coarseness of total grit size.**—The coarseness of the total grit size of the abrasive grain shall satisfy the requirements contained in Table 2.

TABLE 2. *Coarseness of total grit sizes for aluminum oxide, garnet, and silicon carbide*

Grit size	Sieve through which 100% shall pass	Sieve through which at least 99.5% shall pass
6/0–220	13 XX	15 XX.
5/0–180	11 X	13 XX.
4/0–150	9 Std.	11 X.
3/0–120	6 Std.	9 Std.
2/0–100	3 Std.	6 Std.
0–80	1 Std.	3 Std.
1/2–60	38 GG	1 Std.
1–50	32 GG	38 GG
1½–40	28 GG	32 GG.
2–36	24 GG	28 GG.
2½–30	20 XXXGG	24 GG.
3–24	No. 14	20 XXXGG
3½–20	No. 10	No. 14
4–16	No. 8	No. 10.
4½–12	No. 6	No. 8.

[2] A copy of the latest edition of Federal Specification P–C–458, Cloth, Abrasive, Crocus, may be obtained from the Printed Materials Supply Division, General Services Administration, Building 197, Naval Weapons Plant, Washington, D. C. 20407.

[3] For detailed information on sieves see 6.1.2.

4.1.1.2 **Overgrade.**—The overgrade for each grit size is determined with the control sieve. The percentage of the test sample weight of abrasive grain retained on the control sieve shall not exceed that shown by the standard sand by more than 20%.

4.1.1.3 **Fines.**—The fines for each grit size is determined with the fines sieve (see 6.1.3). The percentage of the test sample weight of abrasive grain passing through the fines sieve shall not differ by more than plus 10 percentage points or minus 7 percentage points from that shown by the standard sand.

4.1.2 **Emery and Flint.**

4.1.2.1 **Coarseness of total grit size.**—The coarseness of the total grit size of the abrasive grain shall satisfy the requirements given in Table 3.

TABLE 3. *Coarseness of total grit sizes for emery and flint*

Abrasive grain	Grit size	Sieve through which 100% shall pass	Sieve through which at least 99.5% shall pass
Emery	Fine	5 Std.	8 X.
	Medium	40 GG	5 Std.
	Coarse	28 GG	40 GG.
	Extra coarse	20 XXXGG	24 GG.
Flint:			
(Finishing paper)	4/0	13 XX	15 XX.
(Pouncing paper)	220	do.	Do.
(Snuffing paper)	220	do.	Do.
(Finishing paper)	3/0	11 X	13 XX.
(Snuffing paper)	180	do.	Do.
(Finishing paper)	2/0	9 Std.	11 X.
(Pouncing paper)	150	do.	Do.
Flint (paper) and Flint (roll paper)	Extra fine	5 Std.	10 X.
	Fine	40 GG	5 Std.
	Medium	28 GG	40 GG.
	Coarse	24 GG	28 GG.
Flint (paper)	Extra coarse	20 XXXGG	24 GG.

4.1.2.2 **Overgrade.**—The overgrade percentage of abrasive grain retained on the control sieve shall not exceed that shown by the standard sand by more than 100%.

4.1.2.3 **Fines.**—The percentage of abrasive grain passing through the fines sieve (see 6.1.3) shall not differ by more than plus 15 percentage points or minus 10 percentage points from that shown by the standard sand.

4.2 **Sedimentation grit sizes.**—The abrasive grain for each grit size as recovered from the coated product and tested in accordance with the testing procedure described herein, shall be of such size distribution that its accumulation curve shall not show a particle size in excess of that shown in Figure 1 by the maximum standard curve nor less than that shown by the minimum curve between 3 and 50 percent of the total accumulated height (height-percent).

5. ABRASIVE GRAIN RECOVERY PROCEDURES

5.1 **Screen grit sizes.**—The abrasive grain recovery procedures described herein insure a free flowing mineral when properly conditioned (see 6.1.3.4). This is essential for the accurate determination of grading. These procedures shall be followed in recovering abrasive grain from the screen grit sizes of coated abrasive products for grading.

FIG

Alun
Flint
Flint
Flint

Height Percent	Grit Size (Microns)															
	240		280		320		360		400		500		600			
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.		
%	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ		
3	79.5	76.0	73.0	69.5	62.5	59.0	50.0	47.0	40.0	37.0	34.6	32.0	32.0	29.0		
10	70.8	67.3	62.0	58.5	52.0	48.5	40.5	37.5	33.3	30.3	28.0	25.2	25.2	22.2		
20	64.4	60.9	54.6	51.1	45.3	41.8	35.5	32.5	29.5	26.5	24.5	21.5	20.8	17.8		
30	60.0	56.5	50.3	46.8	41.4	37.9	32.6	29.6	27.1	24.1	22.2	19.2	18.5	15.5		
40	56.5	53.0	47.0	43.5	38.4	34.9	30.5	27.5	25.2	22.2	20.7	17.7	16.8	13.8		
50	53.5	50.0	44.0	40.5	36.0	32.5	28.8	25.8	23.6	20.6	19.7	16.7	16.0	13.0		

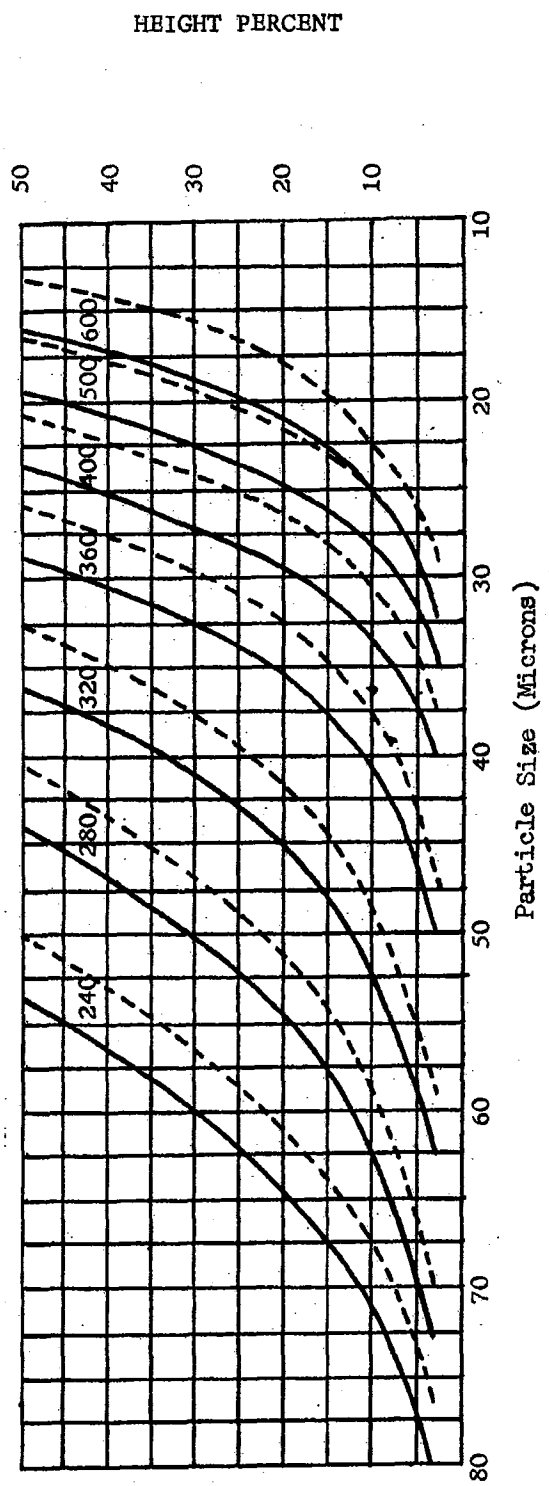

FIGURE 1.—*Standard micron values (accumulation curves) for sedimentation grit sizes.*

Aluminum oxide, garnet, and silicon carbide 600, 500, 400, 360, 320, 280, 240
Flint finishing paper 7/0 (320), 6/0 (280), 5/0 (240)
Flint pouncing paper 400, 360, 320, 280, 240
Flint snuffing paper 400, 320, 280, 240

5.1.1 **Types of bond.**—In the manufacture of coated abrasives, a layer of adhesive called the making coat is first applied to the backing. The abrasive grain is then deposited and a second layer of adhesive called the sizing coat is then applied over the abrasive grain. The combination of making and sizing coats is referred to as the bond and different types of bonds as described below require different recovery procedures.

Glue bond.—Coated abrasive products in which both the making coat and sizing coat consist of animal hide glue which is completely soluble in water.

Modified glue bond.—Coated abrasive products in which both the making coat and sizing coat consist of animal hide glue containing a mineral filler which is not soluble in water.

Resin over glue bond.—Coated abrasive products in which the making coat consists of a type of adhesive which is water soluble or is softened in water and the sizing coat consists of a resin which is insoluble in readily available solvents such as water, alcohol, or caustic. Either or both adhesive coats may or may not contain a mineral filler.

Resin over resin bond.—Coated abrasive products in which both the making coat and sizing coat consist of a resin which is insoluble in readily available solvents such as water, alcohol, or caustic. Either or both adhesive coats may or may not contain filler.

Waterproof.—Coated abrasive products in which the backing is of a waterproof type and both the making and sizing coats consist of a resin or varnish which is insoluble in water. Such coated abrasive products fall into two classifications: those having adhesives which are soluble in readily available solvents such as alcohol or caustic and those which are not.

5.1.2 **Recovery procedure for glue-bond coated abrasives.**—Take a sufficiently large sample of abrasive product to insure recovery (after the sampling methods described in 6.1.3.3) of at least 10 grams of abrasive grain for sieving. Place the sample in a beaker and cover with hot water. When the glue is entirely softened and most of the abrasive grain has fallen off, wash the sample with a jet of hot water and rub or brush it gently to make certain that all of the grain is removed. Follow either Procedure A or B, depending on the grit size and type of abrasive grain of the coated abrasive product.

Procedure A:

For: Grit sizes 6/0–220 through 0–80, aluminum oxide, garnet, and silicon carbide.

Grit sizes fine and medium, emery.
Grit sizes 4/0, 3/0, 2/0, flint (finishing paper).
Grit sizes 220, 150, flint (pouncing paper).
Grit sizes 220, 180, flint (snuffing paper).
Grit sizes extra fine through medium, flint (paper), and (roll paper).

Decant through a Buchner funnel equipped with a No. 4 Whatman filter paper or its equivalent of sufficient diameter to extend at least ¼ in. up the sides of the funnel. If the filter clogs from the clay or other filling material present in the backing of cloth-backed products, wash any abrasive grain on the filter back into the beaker and use a new filter paper for the remaining decanta-

tions, repeating this procedure if necessary. Wash the abrasive grain with hot water at least 4 times by decantation through the filter.

In the case of *products other than emery*, wash any abrasive grain on the filter paper back into the beaker with hot water and add an equal amount of C.P. concentrated HCl. Heat to boiling and boil for 7 to 10 minutes, agitating the grain once or twice during this time. Dilute and decant through a No. 4 Whatman filter or its equivalent in a Buchner funnel. Wash the grain with hot water 3 times by decantation through the filter and finally transfer all of the grain to the filter with hot water. Wash once with alcohol. Dry the grain and filter paper in an oven at 110±5°C. Brush the abrasive grain lightly from the filter paper into a crucible, leaving the bulk of any clay or other filling material from the backing of cloth backed products on the filter paper. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

In the case of emery do not use acid but continue washing by decantation through the filter until the abrasive grain is completely free from adhesive. Transfer all of the abrasive grain to the filter and proceed directly to the alcohol wash, drying and igniting the grain as outlined for products other than emery.

Procedure B:

For: Grit sizes 1/2–60 and coarser, aluminum oxide, garnet, and silicon carbide.

Grit sizes coarse and extra coarse, emery.

Grit sizes coarse and extra coarse, flint (paper).

Grit sizes coarse, flint (roll paper).

Filter through a U. S. Std. Sieve No. 325 and wash the abrasive grain 12 times or more with hot water. Transfer the grain from the sieve to a No. 4 Whatman filter paper or its equivalent with hot water. Wash once with alcohol. Dry the grain and filter paper in an oven at 110±5°C. Brush the grain lightly from the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

5.1.3 **Recovery procedure for modified glue-bond coated abrasives.**—Use the procedure for glue-bond coated abrasives (see 5.1.2). However, in the case of emery grit sizes fine and medium, and all coated abrasives having mineral fillers which are insoluble in HCl or too coarse to pass a No. 325 Sieve, separate the mineral filler from the abrasive grain at some point prior to grading. This separation is made by vibratory means with sieves fine enough to retain all of the abrasive grain but coarse enough to pass all of the mineral filler as determined by microscopic examination of both the abrasive grain and the mineral filler, or it is made by any other means that will insure a clean separation of the mineral filler from the abrasive grain with no loss of the abrasive grain.

5.1.4 , **Recovery procedure for resin over glue-bond coated abrasives containing no mineral filler in the adhesive coats.**—Take a sufficiently large sample to insure recovery (after the sampling method described in 6.1.3.3) of at least 10 grams of abrasive grain for sieving. Place the sample in a beaker and cover with hot water. When the adhesive in the making coat has been sufficiently softened, strip the abrasive grain coating from the backing by hand. Rub the backing gently with the finger tips to remove all traces of the grain. Break the large flakes of coating into relatively small clusters with a stirring rod. Follow either Procedure A or B, depending on the grit size and the type of abrasive grain.

Procedure A:

For: Grit sizes 6/0–220 through 0–80, aluminum oxide, garnet, and silicon carbide.

Grit sizes fine and medium, emery.
Grit sizes 4/0, 3/0, 2/0, flint (finishing paper).
Grit sizes 220, 150 flint (pouncing paper).
Grit sizes 220, 180 flint (snuffing paper).
Grit sizes extra fine through medium, flint (paper) and (roll paper).

Decant through a Buchner funnel equipped with a No. 4 Whatman filter paper or its equivalent of sufficient diameter to extend at least ¼ in. up the sides of the funnel. If the filter clogs from the clay or other filling material present in the backing of cloth backed products, wash any abrasive grain and flakes of coating into the beaker and use a new filter paper for the remaining decantations, repeating this procedure if necessary. Wash the abrasive grain with hot water at least 4 times by decantation through the filter.

Transfer all solids to the filter and wash once with alcohol. Dry the solids and filter paper in an oven at 110±5°C. Leaving on the filter paper the bulk of any clay or other filling material from the backing of cloth backed products, brush the remaining solids lightly from the filter paper into a large crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner. At this point the grain should be fairly free flowing. If this is not the case, it should be further ignited.

Brush the abrasive grain from the crucible into a beaker, add 50% NaOH solution and boil for at least 10 minutes. Dilute with an equal volume of water and decant through a No. 4 Whatman filter paper or its equivalent in a Buchner funnel. Wash the grain with hot water at least 4 times by decantation through the filter.

In the case of *products other than emery,* transfer any abrasive grain on the filter back into the beaker with hot water and add an equal amount of chemically pure (CP) concentrated HCl. Heat to boiling and boil for 7 to 10 minutes, agitating the abrasive grain once or twice during this time. Dilute and decant through a No. 4 Whatman filter paper or its equivalent in a Buchner funnel. Wash the grain with hot water 3 times by decantation

through the filter and finally transfer all of the grain to the filter with hot water. Wash once with alcohol. Dry the abrasive grain and filter paper in an oven at 110±5°C. Brush the grain from the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Perferably, this should be done in a muffle furnace at 600± 20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

In the case of emery, after the NaOH treatment continue washing by decantation through the filter until the abrasive grain is completely free from NaOH. Transfer all of the grain to the filter and proceed directly to the alcohol wash, drying and igniting the grain as outlined for products other than emery.

Procedure B:

For: Grit sizes 1/2–60 and coarser, aluminum oxide, garnet, and silicon carbide.

Grit sizes coarse and extra coarse, emery.

Grit sizes coarse and extra coarse, flint (paper).

Grit sizes coarse, flint (roll paper).

Decant through a No. 325 Sieve and wash the abrasive grain 12 times or more with hot water by decantation through the sieve. Transfer any abrasive grain and flakes of coating remaining on the sieve back into the beaker. Carefully decant this water through the sieve so that no solids are transferred to the sieve and dry the solids in a beaker.

Brush all of the solids into a large crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner. At this point the grain should be fairly free flowing; if this is not the case, it should be further ignited.

Brush the abrasive grain into a beaker, add 50% NaOH solution and boil for at least 10 minutes. Dilute with an equal volume of water and filter through a No. 325 Sieve. Wash the grain with hot water at least 4 times. Transfer any grain from the sieve to a No. 4 Whatman filter paper or its equivalent with hot water. Wash once with alcohol. Dry the abrasive grain and filter paper in an oven at 110±5°C. Brush the grain lightly from the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in muffle furnace at 600± 20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

5.1.5 **Recovery procedure for resin over glue-bond coated abrasives containing a mineral filler in either or both adhesive coats.**—Use the procedure for resin over glue-bond coated abrasives containing no mineral filler in adhesive coats (see 5.1.4). However, in the case of emery grit sizes fine and medium, and all coated abrasives having mineral fillers which are insoluble in HCl or too coarse to pass a No. 325 Sieve, separate the mineral filler from the abrasive grain at some point prior to grading. This separation is made by vibratory means with sieves fine enough to retain all of the abrasive grain, but coarse enough to pass all of the mineral

filler as determined by microscopic examination of both the abrasive grain and the mineral filler, or it is made by any other means that will insure a clean separation of the mineral filler from the abrasive grain with no loss of the abrasive grain.

5.1.6 **Recovery procedure for resin over resin-bond coated abrasive containing no mineral filler in the adhesive coats.**—Take a sufficiently large sample to insure recovery, after the sampling method described in 6.1.3.3 of at least 10 grams of abrasive grain for sieving. Cut the sample over a sheet of glazed paper into approximately one-inch squares. Place the squares and any loose abrasive grain collected on the glazed paper into a large crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner. At this point the grain should be fairly free flowing. If this is not the case, it should be further ignited.

Brush the abrasive grain from the crucible into a beaker, add 50% NaOH solution and boil for at least 10 minutes. Dilute with an equal volume of water. Follow either Procedure A or B depending on the grit size and type of abrasive grain of the coated abrasive product.

Procedure A:

For: Grit sizes 6/0–220 through 0–80, aluminum oxide, garnet, and silicon carbide.

Grit sizes fine and medium, emery.

Grit sizes 4/0, 3/0, 2/0, flint (finishing paper).

Grit sizes 220, 150, flint (pouncing paper).

Grit sizes 220, 180, flint (snuffing paper).

Grit sizes extra fine through medium flint (paper) and (roll paper).

Decant through a No. 4 Whatman filter paper or its equivalent in a Buchner funnel. Wash the abrasive grain with hot water at least 4 times by decantation through the filter.

In the case of products other than emery, transfer any abrasive grain on the filter into a beaker with hot water and add an equal amount of C. P. concentrated HCl. Heat to boiling and boil for 7 to 10 minutes, agitating the grain once or twice during this time. Dilute and decant through a No. 4 Whatman filter paper or its equivalent in a Buchner funnel. Wash the abrasive grain with hot water 3 times by decantation through the filter and finally transfer all of the grain to the filter with hot water. Wash once with alcohol. Dry the grain and filter paper in an oven at 110± 5°C. Brush the grain from the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

In the case of emery (after the NaOH treatment), continue washing by decantation through the filter until the abrasive grain is completely free from NaOH. Transfer all of the grain to the filter and proceed directly to the alcohol wash, drying and igniting the grain as outlined for products other than emery.

Procedure B:

For: Grit sizes 1/2–60 and coarser, aluminum oxide, garnet, and silicon carbide.

Grit sizes coarse and extra coarse, emery.

Grit sizes coarse and extra coarse, flint (paper).

Grit sizes coarse, flint (roll paper).

Decant through a No. 325 Sieve. Wash the abrasive grain with hot water at least 4 times by decantation through the sieve. Transfer any grain remaining on the sieve and that in the beaker onto a No. 4 Whatman filter paper or its equivalent with hot water. Wash once with alcohol. Dry the grain and filter paper in an oven at 110±5°C. Brush the grain lightly from the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

5.1.7 **Recovery procedure for resin over resin-bond coated abrasives containing a mineral filler in either or both adhesive coats.**—Use the procedure for resin over resin-bond coated abrasives containing no mineral filler in adhesive coats (see 5.1.6). However, in the case of emery grits fine and medium and all coated abrasives having mineral fillers which are insoluble in HCl or too coarse to pass a No. 325 Sieve, separate the mineral filler from the abrasive grain at some point prior to grading. This separation is made by vibratory means with sieves fine enough to retain all of the abrasive grain but coarse enough to pass all of the mineral filler as determined by microscopic examination of both the abrasive grain and the mineral filler, or it is made by any other means that will insure a clean separation of the filler from the abrasive grain with no loss of the abrasive grain.

5.1.8 **Recovery procedure for paper backed waterproof coated abrasives containing no mineral filler in adhesive coats and having adhesive coats which are soluble in denatured alcohol and caustic-water-methanol.**[4]—Take a sufficiently large sample to insure recovery of at least 10 grams of abrasive grain for sieving. Cut the sample into 1½ in. strips and fold, preferably in a zigzag manner, and place on edge in a 600 ml beaker. Just cover strips with equal volumes of denatured alcohol or equivalent and caustic-water-methanol solution. Boil until the abrasive grain drops off and remove strips, washing off any adhering grain with denatured alcohol. Bring solution to boil and hold for 5 minutes. Decant through a Buchner funnel equipped with a No. 4 Whatman filter paper or its equivalent of sufficient diameter to extend at least ¼ in. up the side of the funnel. Rinse thoroughly with hot water and finally with denatured alcohol.

Remove the filter paper, wash the abrasive grain into a 600 ml beaker with approximately 100 ml of hot water, and discard the filter paper. Add an equal volume of C.P. concentrated HCl to the beaker containing the grain and water, and boil approximately 10 minutes, stirring occasionally. Dilute with about 50 ml of hot water and filter through a No. 4 Whatman filter paper

[4] Caustic-water-methanol solution consists of equal parts by volume of a 10% NaOH solution and methanol.

or its equivalent. Rinse thoroughly, first with hot water and then with denatured alcohol.

Dry the filter paper and the sample in a drying oven at 110± 5°C, and transfer sample to an evaporating dish, and discard filter paper. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

5.1.9 **Recovery procedure for paper backed and other waterproof coated abrasives containing no mineral filler in adhesive coats and having adhesive coats (such as phenol-aldehyde resins) which are insoluble in readily available solvents.**—Use the procedure for resin over resin-bond coated abrasives containing no mineral filler in adhesive coats (see 5.1.6).

5.1.10 **Recovery procedure for paper backed and other waterproof coated abrasives containing a mineral filler in either or both adhesive coats and having adhesive coats (such as phenol-aldehyde resins) which are insoluble in readily available solvents.**—Use the procedure for resin over resin-bond coated abrasives containing a mineral filler in either or both adhesive coats (see 5.1.7).

5.2 **Sedimentation grit sizes.**—The abrasive grain recovery procedures described herein for sedimentation grit sizes insure grain particles which will be wet uniformly by the sedimentation medium without forming air bubbles. Thorough wetting of each particle is necessary to obtain accurate results. These procedures shall be followed in recovering abrasive grain from sedimentation grit sizes of coated abrasive products for grading.

5.2.1 **Types of bond.**—The different types of bond are defined in 5.1.1.

5.2.2 **Recovery procedure for glue-bond coated abrasives.**—Take a sufficiently large sample of abrasive product to insure at least 2 to 2½ grams of abrasive grain for testing. Cut the sample into approximately 1 in. strips. Fold each strip individually in a zigzag manner and place the strips on edge in a 600 ml beaker. Add sufficient hot distilled water to cover the strips and heat until the grain is removed, but do not boil. Wash the pieces of backing with a jet of hot distilled water from a wash bottle, brushing or rubbing each strip gently to make certain that all of the grain is removed.

After the abrasive grain has been removed from the coated sheet, decant the liquid in the beaker through an 11 cm No. 42 Whatman filter paper placed in a Bunsen funnel with a platinum filter cone, using suction, or decant through a No. 42 Whatman filter paper of sufficient diameter to provide a ½ in. collar when placed in a Buchner funnel, using suction.

Add approximately 20 to 40 ml of a solution of equal parts by volume of C.P. concentrated HCl and distilled water to the beaker containing the abrasive grain. Bring to a boil and boil for 5 to 7 minutes. Dilute with an equal volume of hot distilled water, decant through the filter paper, and transfer the grain to the filter paper using hot distilled water. Wash the grain and filter paper thoroughly with hot distilled water and then with denatured alcohol, or methanol.

Remove the filter paper and abrasive grain to a crucible (either nickel or porcelain). With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

5.2.3 **Recovery procedure for waterproof coated abrasives made with adhesives which are soluble in denatured alcohol, and caustic-water-methanol.**—Take a sufficiently large sample of abrasive product to insure recovery of at least 2 to 2½ grams of abrasive grain. Cut the equivalent of one 9 in. × 11 in. sheet into approximately 1 in. strips. Fold individually in a zigzag manner and place on edge in a 600 ml beaker. Just cover strips with equal volumes of denatured alcohol or equivalent, and caustic-water-methanol solution. Boil until the grain drops off and remove strips, washing off any adhering grain with denatured alcohol. Bring solution to boil and boil for ten minutes, then filter by means of suction using an 11 cm No. 42 Whatman filter paper in a Bunsen funnel with a platinum filter cone. It is optional to use a Buchner funnel and larger filter paper which provides a ½ in. collar on the funnel sizes. Rinse thoroughly with hot distilled water (10 times, approximately 25 ml each), and with methanol or denatured alcohol (5 times, approximately 25 ml each).

Remove the filter paper and wash the grain into a 600 ml beaker with approximately 100 ml of hot distilled water. Dry and burn filter paper and add any grain or residue remaining to the beaker. Add an equal volume of C.P. concentrated HCl to the beaker containing the water and grain and boil approximately 10 minutes, stirring occasionally. Dilute with about 50 ml of hot distilled water, and filter through No. 42 Whatman filter paper. Rinse thoroughly with hot distilled water (10 times, 25 ml each); and then with methanol or denatured alcohol (5 times, 25 ml each).

Dry filter paper and sample in a drying oven at 110±5°C and then break up all lumps with a spatula. Place the filter paper and the grain in a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner. Stir sample at least twice before removing. Break up any lumps or clustering by working over lightly but thoroughly with a spatula.

5.2.4 **Recovery procedure for resin over glue-bond, resin over resin-bond, and waterproof coated abrasives made with one or more adhesive coats which are insoluble in readily available solvents.**—Take one 9 in. × 11 in. sheet or a sample sufficiently large to obtain at least 2 to 2½ grams of abrasive grain. Cut the sample over a sheet of glazed paper into approximately 1 in. squares. Place the squares and any loose grain collected on the glazed paper into a large crucible or evaporating dish. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner. At this

point the abrasive grain should be fairly free flowing; if this is not the case, it should be further ignited.

Brush the abrasive grain into a beaker, add 50% NaOH solution and boil for at least 10 minutes. Dilute with an equal volume of distilled water. Decant through a No. 42 Whatman filter paper or its equivalent in a Buchner funnel using a size of filter paper which provides a ½ in. collar on the funnel sides. Wash the grain thoroughly with hot distilled water, by decantation through the filter.

Transfer any abrasive grain on the filter back into the beaker with a jet of hot distilled water and add an equal volume of C.P. concentrated HCl. Heat to boiling and boil for 7 to 10 minutes agitating the grain once or twice during this time. Dilute and decant through a No. 42 Whatman filter paper, or its equivalent, in a Buchner funnel. Wash the grain 3 times by decantation through the filter and, finally, transfer all of the grain to the filter paper with hot distilled water. Wash once with denatured alcohol or methanol. Dry the grain and filter paper in an oven at 110±5°C. Place the grain and the filter paper into a crucible. With occasional stirring, ignite the abrasive grain until all combustible material is burned to an ash. Preferably, this should be done in a muffle furnace at 600±20°C, but if such equipment is not available, the ignition may be done over a Bunsen or Meker burner.

6. TESTING PROCEDURE

6.1 **Screen grit sizes.**

6.1.1 **Standard sands.**—The standard sands used for the determination of conformity to the grading limits of screen grit sizes for the various types of abrasive grain are listed in Tables 4 and 5.

6.1.2 **Test sieves.**—The nominal aperture opening and mesh of the test sieves used for the determination of the screen grit sizes of abrasive grain are given in Table 6. These test sieves have an inside diameter of approximately 4 inches and shall have not less than 12 square in. of screening area.[5] The silk bolting cloth shall be carefully selected for mesh count and uniformity of openings, and shall be mounted taut in the frame without unduly disturbing either the size or the shape of the openings.

6.1.3 **Method of test.**

6.1.3.1 **Control of screen grit sizes.**—The standard sands are used to check the sieving characteristics of the test sieves for the purpose of determining their suitability for use (see 6.1.3.2), and to provide a reference for evaluating the grading of abrasive grain recovered from the coated sheet (see 4.1).

6.1.3.2 **Selection of test sieves.**—The test sieves to be used for determining the grading of screen grit sizes are shown in Tables 7 and 8. Before they may be considered as being satisfactory for use, they shall be tested by use of "standard sands" in the manner described herein.

If a sieve is used as the control sieve for any type and grit size of abrasive grain, it shall be tested as a control sieve using the

[5] Special frames for these sieves are available from the Carborundum Co., Niagara Falls, New York 14302.

"standard sand" for that type and grit size of abrasive grain. It shall be considered as being satisfactory for use as a test sieve only if, and as long as, it yields an overgrade percentage by weight within the limits shown in Tables 7 and 8.

TABLE 4. *Standard sands for aluminum oxide, emery, garnet, and silicon carbide*

Grit size	Type of abrasive grain	Standard sand [1]	
		Mineral	Date
6/0–220	Aluminum oxide, silicon carbide, & garnet	Garnet	3/12/52.
5/0–180	Aluminum oxide	do.	8/05/52.
5/0–180	Silicon carbide & garnet	do.	7/01/52.
4/0–150	Aluminum oxide, silicon carbide, & garnet	do.	12/23/53.
3/0–120	Aluminum oxide & silicon carbide	do.	4/21/55.
3/0–120	Garnet	do.	2/20/51
2/0–100	Aluminum oxide & silicon carbide	do.	4/16/54
2/0–100	Garnet	do.	4/20/50.
0–80	Aluminum oxide	do.	4/20/50.
0–80	Silicon carbide & garnet	do.	11/24/52.
1/2–60	Aluminum oxide, silicon carbide, & garnet	do.	1/18/55.
1–50	Aluminum oxide, silicon carbide, & garnet	do.	6/04/53.
1½–40	Aluminum oxide, silicon carbide, & garnet	do.	1/10/51.
2–36	Aluminum oxide	do.	6/00/43.
2–36	Silicon carbide & garnet	do.	6/30/55.
2½–30	Aluminum oxide	do.	3/01/56.
2½–30	Silicon carbide & garnet	do.	10/25/49.
3–24	Aluminum oxide	do.	6/24/54.
3–24	Silicon carbide & garnet	do.	5/09/52.
3½–20	Garnet	do.	7/27/55.
3½–20	Aluminum oxide & silicon carbide	do.	11/00/41.
4–16	Aluminum oxide	Al. ox.	6/11/52.
4–16	Silicon carbide	do.	3/00/32.
4½–12	Aluminum oxide & silicon carbide	do.	11/10/47.
Fine	Emery	Emery	1/05/55.
Medium	do.	do.	Do.
Coarse	do.	do.	Do.
Extra coarse	do.	do.	Do.

[1] The standard sands designated for aluminum oxide, silicon carbide, garnet, and emery may be purchased from the Carborundum Co., Niagara Falls, New York 14302. The dates are included for the purpose of identification, and represent the standard sands that are currently in use by the industry.

TABLE 5. *Standard sands for flint*

Grit size	Type of paper product	Standard sand	
		Mineral	Date
4/0	Flint finishing paper	Garnet [1]	3/12/52
220	Flint pouncing paper	do.	Do.
220	Flint snuffing paper	do.	Do.
3/0	Flint finishing paper	do.	8/05/52
180	Flint snuffing paper	do.	Do.
2/0	Flint finishing paper	do.	12/23/53
150	Flint pouncing paper	do.	Do.
Extra fine	Flint paper and roll paper	Quartz [2]	4/01/52
Fine	do.	do.	Do.
Medium	do.	do.	Do.
Coarse	do.	do.	Do.
Extra coarse	Flint paper	do.	Do.

[1] The standard sand for 4/0 flint finishing paper, 220 flint pouncing paper, and 220 flint snuffing paper is the same as the standard sand for 6/0–220 aluminum oxide, silicon carbide, and garnet: that for 3/0 flint finishing paper and 180 flint snuffing paper is the same as the standard sand for 5/0–180 aluminum oxide, and that for 2/0 flint finishing paper and 150 flint pouncing paper is the same as the standard sand for 4/0–150 aluminum oxide, silicon carbide, and garnet. These standard sands may be purchased from The Carborundum Company, Niagara Falls, N. Y. 14302.

[2] The standard sands for flint paper may be obtained from the Minnesota Mining and Manufacturing Company, 2501 Hudson Road, St. Paul, Minnesota 55119.

TABLE 6. *Nominal aperture openings and mesh of Coated Abrasives Manufacturers' Institute test sieves for controlling screen grit sizes of abrasive grain*

Sieve cloth designation	Aperture opening	Mesh (warp and weft)
Silk bolting cloth [1]	Inch	Openings per inch
25 Std. Dufour	0.0025 [2]	196 [3]
21 Std. Dufour	.0027	178
16 X Dufour	.0032	157
15 XX Dufour	.0036	150
13 XX Dufour	.0039	129
11 X Dufour	.0052	116
10 X Dufour	.0058	109
9 Std. Dufour	.0066	97.5
8 X Dufour	.0079	85.5
6 Std. Bodmer	.0094	74
5 Std. Dufour	.0111	66
3 Std. Dufour	.0131	58.5
1 Std. Dufour	.0164	48.5
40 GG Dufour	.0197	39
38 GG Dufour	.0215	37
32 GG Bodmer	.0250	32
28 GG Dufour	.0304	27.5
24 GG Bodmer	.0353	24
20 XXXGG Dufour	.0456	19.5
18 GG Dufour	.0519	17.5
Wire cloth [4]		
No. 14	0.0555	—
No. 12	.0661	—
No. 10	.0787	—
No. 8	.0937	—
No. 6	.1320	—

[1] Pieces of silk bolting cloth suitable for these CAMI sieve frames are available from the Carborundum Co., Niagara Falls, New York 14302.

[2] The nominal aperture opening for each silk cloth represents the mode or aperture of most frequent occurrence in 100 openings measured between warp threads. Measurements made by other methods will give noticeably different results. This should be kept in mind in making comparisons between the figures shown and other figures.

[3] The values for the mesh are the standard counts of the manufacturer's of the silk bolting cloth, adjusted to the nearest full or ½ mesh. Mesh count in the warp direction is subject to minor variations and is as a rule within ±1% of the standard count. Mesh count in the weft direction is subject to somewhat greater variations.

[4] The wire cloth for placing in CAMI sieve frames may be obtained from the Newark Wire Cloth Co., 351 Verona Ave., Newark, New Jersey 07104 or from the W. S. Tyler Co., 3615 Superior Ave., Cleveland, Ohio 44114. The Wire cloths comply with the American Society for Testing and Materials' Standard Designation E11, Specifications for Sieves for Testing Purposes. Copies may be obtained from the ASTM's office, 1916 Race Street, Philadelphia, Pennsylvania 19103.

If the same sieve is used to test the "coarseness of total grit size" or is used as the fines sieve for either a coarser grit size of the same type of abrasive grain or for any grit size for some other type of abrasive grain, it shall be considered as being satisfactory for such use if it has been tested and found to be satisfactory as a control sieve.

Certain sieves, namely, the ones using 25 Std, and 18GG silk cloth, and No. 12 wire cloth are fines sieves only. Each of these shall be tested as a fines sieve using the standard sand for the grit size and type of abrasive grain for which it is a fines sieve. Each shall be considered satisfactory for use as a test sieve only if, and as long as, it yields a fines percentage by weight within the limits shown in Tables 7 and 8.

Sieves using No. 8 and No. 6 wire cloth are only for testing the "coarseness of total grit size" of sizes 4–16 and 4½–12; therefore, they do not need to be tested with the standard sands to

TABLE 7. *Limits within which the control and fines sieves must separate the standard sands for aluminum oxide, silicon carbide, and garnet abrasive grain, and sieves used for testing the coarseness of total grit size* [1]

Grit size	Type of abrasive grain	Coarseness of total size		Control sieve	Overgrade percentage [2]		Fines sieve	Fines Percentage [2]	
		Sieve for 100% passage	Sieve for 99.5% passage		Min.	Max.		Min.	Max.
6/0–220	Aluminum oxide, silicon carbide, and garnet	13 XX	15 XX	21 Std	5.1	9.1	25 Std	45.4	65.4
5/0–180	Aluminum oxide	11 X	13 XX	15 XX	7.3	13.3	21 Std		
5/0–180	Silicon carbide and garnet	11 X	13 XX	15 XX	9.5	15.5	21 Std		
4/0–150	Aluminum oxide, silicon carbide, and garnet	9 Std	11 X	13 XX	6.7	12.7	15 XX		
3/0–120	Aluminum oxide and silicon carbide	6 Std	9 Std	11 X	10.9	16.9	13 XX		
3/0–120	Garnet	6 Std	9 Std	11 X	5.5	11.5	13 XX		
2/0–100	Aluminum oxide and silicon carbide	3 Std	6 Std	9 Std	3.0	6.0	11 X		
2/0–100	Garnet	3 Std	6 Std	9 Std	6.3	12.3	11 X		
0–80	Aluminum oxide	1 Std	3 Std	6 Std	8.4	14.4	9 Std		
0–80	Silicon carbide and garnet	1 Std	3 Std	6 Std	3.0	5.3	9 Std		
1/2–60	Aluminum oxide, silicon carbide, and garnet	38 GG	1 Std	3 Std	4.4	8.4	6 Std		
1–50	Aluminum oxide, silicon carbide, and garnet	32 GG	38 GG	1 Std	3.0	6.4	3 Std		
1½–40	Aluminum oxide, silicon carbide, and garnet	28 GG	32 GG	38 GG	3.0	6.0	1 Std		
2–36	Aluminum oxide	24 GG	28 GG	32 GG	9.7	15.7	38 GG		
2–36	Silicon carbide and garnet	24 GG	28 GG	32 GG	5.3	9.3	38 GG		
2½–30	Aluminum oxide	20 XXXGG	24 GG	28 GG	3.0	7.0	32 GG		
2½–30	Silicon carbide and garnet	20 XXXGG	24 GG	28 GG	14.6	20.6	32 GG		
3–24	Aluminum oxide	No. 14	20 XXXGG	24 GG	8.6	14.6	28 GG		
3–24	Silicon carbide and garnet	No. 14	20 XXXGG	24 GG	8.3	14.3	28 GG		
3½–20	Garnet	No. 10	No. 14	20 XXXGG	3.0	6.9	24 GG		
3½–20	Aluminum oxide and silicon carbide	No. 10	No. 14	20 XXXGG	3.7	7.7	24 GG		
4–16	Aluminum oxide	No. 8	No. 10	No. 14	10.5	16.5	18 GG	20.4	30.4
4–16	Silicon carbide	No. 8	No. 10	No. 14	9.6	15.6	18 GG	15.6	25.6
4½–12	Aluminum oxide and silicon carbide	No. 6	No. 8	No. 10	7.0	13.0	No. 12	34.0	54.0

[1] For detailed information on sieves, see Table 6.
[2] If a sieve does not separate the standard sand within these limits it must be discarded (see 6.1.3.2).

TABLE 8. *Limits within which the control and fines sieves must separate the standard sands for emery and flint abrasive grain, and sieves used for testing the coarseness of total grit size* [1]

Grit size	Type of abrasive grain	Coarseness of total size		Control sieve	Overgrade percentage [2]		Fines sieve	Fines Percentage [2]	
		Sieve for 100% passage	Sieve for 99.5% passage		Min.	Max.		Min.	Max.
Fine	Emery	5 Std	8 X	13 XX	7.3	15.3	21 Std		
Medium	do.	40 GG	5 Std	8 X	4.6	10.6	13 XX		
Coarse	do.	28 GG	40 GG	5 Std	4.3	12.3	9 Std		
Extra coarse	do.	20 XXXGG	24 GG	1 Std	7.5	15.5	5 Std		
Extra fine	Flint (paper & roll paper)	5 Std	10 X	16 X	12.5	20.5	25 Std	20.0	50.0
Fine	do.	40 GG	5 Std	10 X	6.0	14.0	16 X		
Medium	do.	28 GG	40 GG	5 Std	6.0	14.0	10 X		
Coarse	do.	24 GG	28 GG	40 GG	4.1	12.1	5 Std		
Extra coarse	Flint (paper)	20 XXXGG	24 GG	28 GG	3.6	9.6	40 GG		
4/0	Flint (finishing paper)	13 XX	15 XX	21 Std	5.1	9.1	25 Std	45.4	65.4
220	Flint (pouncing paper)	do.	do.	do.	5.1	9.1	do.	45.4	65.4
220	Flint (snuffing paper)	do.	do.	do.	5.1	9.1	do.	45.4	65.4
3/0	Flint (finishing paper)	11 X	13 XX	15 XX	7.3	13.3	21 Std		
180	Flint (snuffing paper)	do.	do.	do.	7.3	13.3	do.		
2/0	Flint (finishing paper)	9 Std	11 X	13 XX	6.7	12.7	15 XX		
150	Flint (pouncing paper)	do.	do.	do.	6.7	12.7	do.		

[1] For detailed information on sieves see Table 6.
[2] If a sieve does not separate the standard sand within these limits, it must be discarded (see 6.1.3.2).

determine their suitability for such use, but must comply with ASTM E–11, Specification for Sieves for Testing Purposes.

6.1.3.3 **Sampling.**—Abrasive grain samples recovered as described in 5.1, and standard sands which are to be tested for grading, shall be reduced to proper weight by quartering, as follows:

Place the abrasive grain on a square piece of hard surfaced paper. Grasp diagonally opposite corners of the paper, raise first one corner then the other, causing the grain to roll from the center of the sheet toward one corner, then across toward the opposite corner, and then back to the center. Next, grasp the other two diagonally opposite corners and repeat the procedure. Continue mixing in this manner for at least five complete cycles in each direction and finally shape the abrasive grain into a flat circular pile in the center of the sheet.

By means of a large spatula inserted from the top of the pile of grain, carefully split the pile first into halves and then into quarters. In each operation the edge of the spatula should be held firmly against the paper so that all the grain is removed. Using a spatula, and a camel hair brush if necessary, completely remove two diagonally opposite quarters.

Repeat this entire procedure with the remaining abrasive grain except after mixing remove the quarters at 90° to those previously removed. Continue repeating the procedure removing alternate quarters after each mixing until substantially the amount required for testing remains (at least 10 grams). Minor adjustments to the final amount may be made by use of a spatula.

6.1.3.4 **Conditioning.**—All quartered samples and test equipment shall be conditioned in a room held at 21±1°C (70±2°F) and 50±2% relative humidity for at least 8 hours before testing, and shall remain under these controlled ambient conditions until all testing is completed.

6.1.3.5 **Mechanical sieving.**—Testing to determine the size distribution of the abrasive grain (as recovered from the coated abrasive product in accordance with Section 5) shall be performed by sieving on a sieve shaking machine.[6] A 10 gram sample of abrasive grain shall be used for calibrating the test sieves and for the size determinations. The control sieve is positioned directly above the fines sieve in the shaker so that when the abrasive grain being tested is placed on the control sieve, that portion of it passing the control sieve will feed directly into the fines sieve. The rate of shaking shall be approximately 275 complete strokes or cycles per minute, and the sieves shall rotate at the rate of approximately 9 revolutions per minute. The test shall be continued until 2750 strokes or cycles have been completed.

In the case of abrasive grain recovered from the coated sheet, after weighing the overgrade, control, and fines portions, the overgrade portion is then rescreened in the same manner, for coarseness of total grit size using the sieves listed in Tables 2 and 3 to determine compliance with the limits shown.

[6] Mechanical sieve shakers especially designed to meet the requirements of this Product Standard may be purchased from The Carborundum Company, Buffalo Avenue, Niagara Falls, New York 14302.

6.1.3.6 **Hand sieving (alternate).**—Hand sieving may be used as an alternative method of test provided that the ambient conditions described in 6.1.3.5 are maintained. A 10 gram sample of abrasive grain shall be tested first through the fines sieve, then through the control sieve. That portion of the abrasive grain remaining on the control sieve shall then be tested in the same manner for coarseness of total grit size using the sieves listed in Tables 2 and 3 to determine compliance with the limits shown. The sieves shall be shaken in substantially a horizontal position by striking the side of the sieve frame against the palm of the hand. A stroke of approximately one inch shall be used and the rate of shaking shall be approximately 275 strokes or cycles per minute. The sieve frames shall not be struck with or against any hard object during sieving. Shaking shall be continued with each sieve until the amount of abrasive grain passing through the sieve is equal to or less than 1% by weight per minute.

6.1.3.7 **Presentation of data (example of normal test result).**—The data in Table 9 illustrates a normal test result for a 3/0–120 aluminum oxide coated abrasive product as obtained by recovering the abrasive grain from the coated sheet and testing it according to the procedures described herein.

TABLE 9. *Test example for 3/0–120 aluminum oxide*

Sieving results	Std. sand	Sample	Required limits
Percent through 6 Std	.....	100.0	100%.
Percent through 9 Std	.....	99.7	99.5 Min.
Percent on 11 X	13.9	12.0	16.7 Max–20% more than Std.
Percent on 13 XX	59.4	63.0	
Percent through 13 XX	26.7	25.0	19.7 Min. (Std. —7% points). 36.7 Max. (Std. +10% points).

6.1.3.8 **Referee test.**—Whenever the test results are a point of issue, duplicate tests shall be made of the abrasive grain in question and its standard sand, and in each instance the standard sand shall be tested either immediately before or after the abrasive grain in question.

6.2 **Sedimentation grit sizes.**

6.2.1 **Theory of grading by sedimentation.**—The method of determining the particle size distribution of an abrasive grain by sedimentation is based on Stokes' Law which, as applied to small spheres falling is a viscous liquid, may be expressed in the following form:

(1) $V=\frac{2\,gr^2\,(p-d)}{9n}$

V =Settling velocity of the falling particle in centimeters per second.

g =Acceleration due to gravity, 980 centimeters per second per second.[7]

r =Effective particle radius in centimeters.

p =Density of the individual particles in grams per cubic centimeter.

[7] The value of g, the acceleration due to gravity, depends upon altitude and latitude. The International Committee on Weights and Measures has adopted as an acceptable value a figure of 980.665 cm per second per second. However, the value 980 may be used as sufficiently accurate.

d = Density of the sedimentation medium in grams per cubic centimeter.

n = Viscosity of the sedimentation medium in poises, i.e., in dyne seconds per square centimeter.

From equation (1):

(2) r (in cm) $= \sqrt{\frac{9nV}{2g(p-d)}}$

D = Effective particle diameter in microns = 10,000 $(2r)$ because 1 cm = 10,000 microns.

Therefore:

(3) D (in microns) $= 20{,}000 \sqrt{\frac{9nV}{2g\ (p-d)}}$

V (in centimeters per second) $= \frac{L}{60T}$

L = Length of sedimentation tube in centimeters.

T = Time of settling in minutes.

(4) D (in microns) $= 20{,}000 \sqrt{\frac{9nL}{2g\ (p-d)\ 60T}}$.

The terms n, L, g, p, and d are all constant for a given sedimentation medium temperature, abrasive grain, locality, and equipment, therefore

$$20{,}000 \sqrt{\frac{9nL}{2g\ (p-d)\ 60}}$$

may be considered as a constant, K, and equation (4) may be written in the following term:

(5) D (in microns) $= K \sqrt{\frac{1}{T}} = \frac{K}{\sqrt{T}}$.

In applying equation (5), it is, of course, necessary to compute the value of K for each temperature and for each type of abrasive grain since K is dependent not only upon L, g, and p, but also upon d and n, the density and viscosity of the sedimentation medium, respectively, both of which are variables with respect to temperature (see par. 6.2.5.4).

6.2.2 **Standard sedimentation apparatus.**[8]—The sedimentation apparatus to be used for the determination of the size distribution of sedimentation grit sizes shall consist of the following elements which shall be assembled as shown in Figure 2.

(1) Glass water jacket, length 87 to 90 cm; outside diameter 6 to 9 cm.

(2) Sedimentation tube shall be cylindrical in shape, length 94 cm; inside diameter 20 mm ± ½ mm.

(3) Collecting tube of special design equal in all respects to that shown in Figure 2. It is important that dimension from the end of the tube to the first graduation mark be correct. If too long, grind to proper length. The end of the tube shall be open and cut off square with the walls. All of the graduations shall be accurately etched on the tube.[9]

[8] The standard sedimentation apparatus and the standard sedimentation medium may be obtained from Minnesota Mining and Manufacturing Co., 2501 Hudson Rd., St. Paul, Minnesota 55119.

[9] Suitable tubes may be obtained from Ace Glass Co., Vineland, New Jersey, Catalog No. T4342.

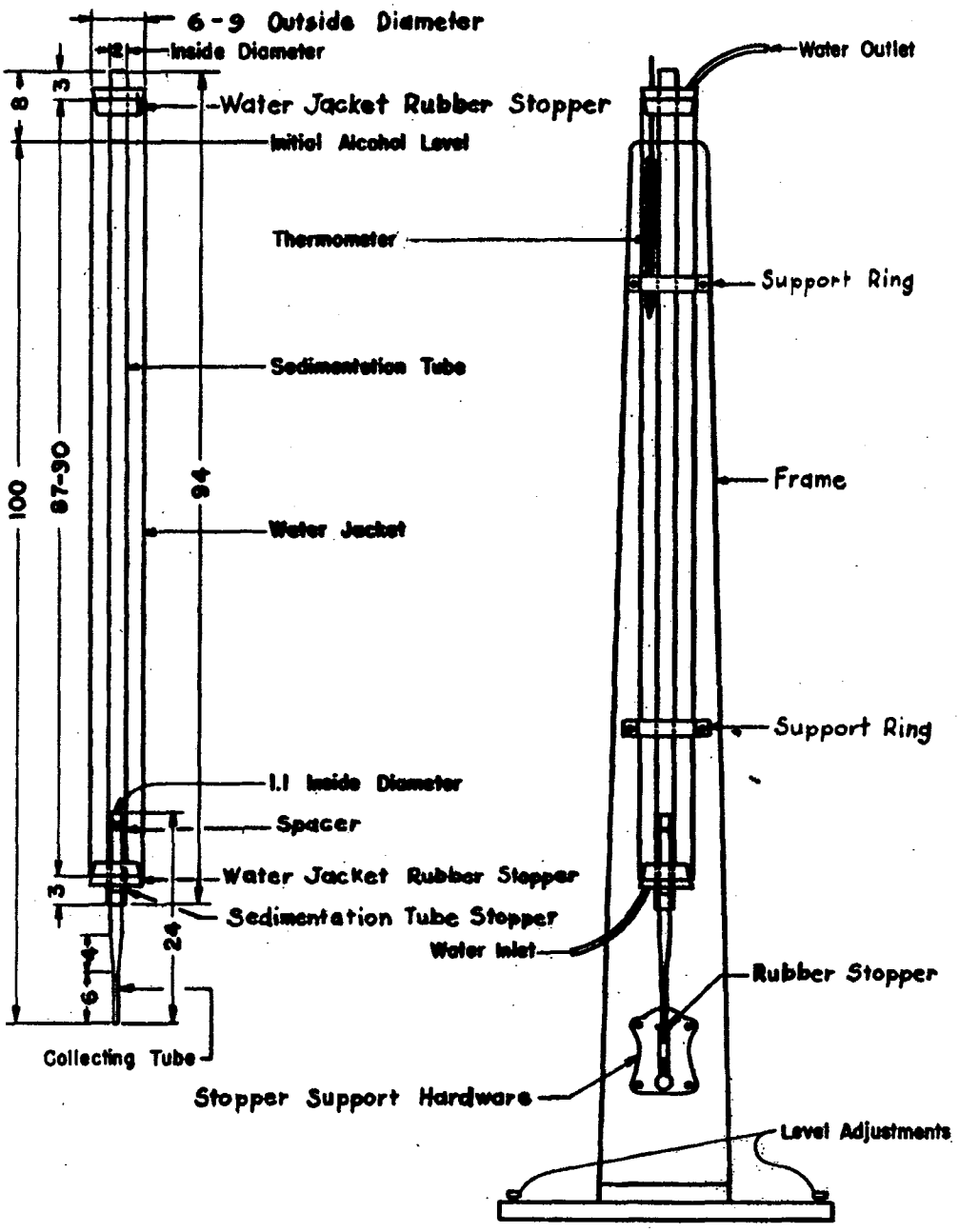

FIGURE 2. *Assembly of standard sedimentation apparatus.*
(Dimensions in centimeters)

(4) Thermometer graduated from 0 to 100°C and calibrated to an accuracy of ±0.2°C.

(5) Stop watch or accurate electric clock capable of being read to $\frac{1}{100}$ of a minute.

(6) Frame equipped with the necessary rings and fittings to hold the glass water jacket, sedimentation tube, collecting tube, rubber stopper, and support hardware.

(7) A metal base plate large enough and heavy enough to give stability to the apparatus, drilled for mounting the frame, and equipped with adjusting screws to permit adjustment of the assembly to a vertical position.

(8) The following accessories:

Test tube and stoppers	Seamless funnel
Wash bottle	Meter stick
Plumb bob	Rubber policemen
Magnifying glass	Medicine dropper

(9) The rubber centering and supporting spacer has a 1.98 cm O. D., and 1.27 cm I. D. with 8 notches 22.5° wide equally spaced about the periphery approximately 0.2 cm deep.

(10) The sedimentation tube rubber stopper has approximately 1.19 cm I. D., 2.6 cm length, and a large diameter of 2.4 cm and a small diameter of 1.8 cm (tapered shape).

6.2.3 **Sedimentation medium.**—The sedimentation medium shall consist of a mixture of 95% methyl alcohol and 99% methyl alcohol (synthetic methanol) which has been carefully blended to provide the required density and viscosity (see 6.2.5.4).

6.2.3.1 **Dispersing agent.**—A dispersing agent consisting of 1% aqueous solution of a tetra-sodium salt of ethylenediamine tetra-acetic acid [10] shall be used as specified in 6.2.5.3.

6.2.4 **Checking minerals**[11].—The checking minerals consist of two carefully prepared size distributions of silicon carbide abrasive grain numbered 280 and 320.

6.2.4.1 **Curves for checking minerals.**—A certified accumulation curve shall be supplied with each lot of checking mineral. The micron sizes of the certified accumulation curve shall agree to within ±2% at 10, 20, 30, 40, and 50 percent of the total accumulated height with the appropriate standard accumulation curves shown in Figure 3.

6.2.5 **Methods of tests.**

6.2.5.1 **Control of sedimentation grit sizes.**—The checking minerals are used to check the sedimentation apparatus, the sedimentation medium, and the testing technique. The conformity of a sedimentation grit size shall be determined with respect to its standard curves shown in Figure 1, only after the above checks have been carried out as outlined in 6.2.5.2.

6.2.5.2 **Calibration of equipment.**—After the sedimentation apparatus has been assembled, it shall be checked for several important variables any one of which might easily impair the accuracy of results. First, check the perpendicularity of the assembled stack by means of the plumb bob on a fine thread suspended on a cross wire from the top to the sedimentation tube in such a manner that the thread passes down through the collecting tube. If the thread does not pass through the center of both the sedimentation tube and the collecting tube, adjust the perpendicularity of

[10] Such as "Versene" by Dow Chemical Company.

[11] A suitable set of checking minerals may be obtained from the Minnesota Mining and Manufacturing Co., 2501 Hudson Rd., St. Paul, Minn. 55119. These checking minerals have been treated according to the procedure outlined for preparing sedimentation grades, and need no further treatment to insure good wetting.

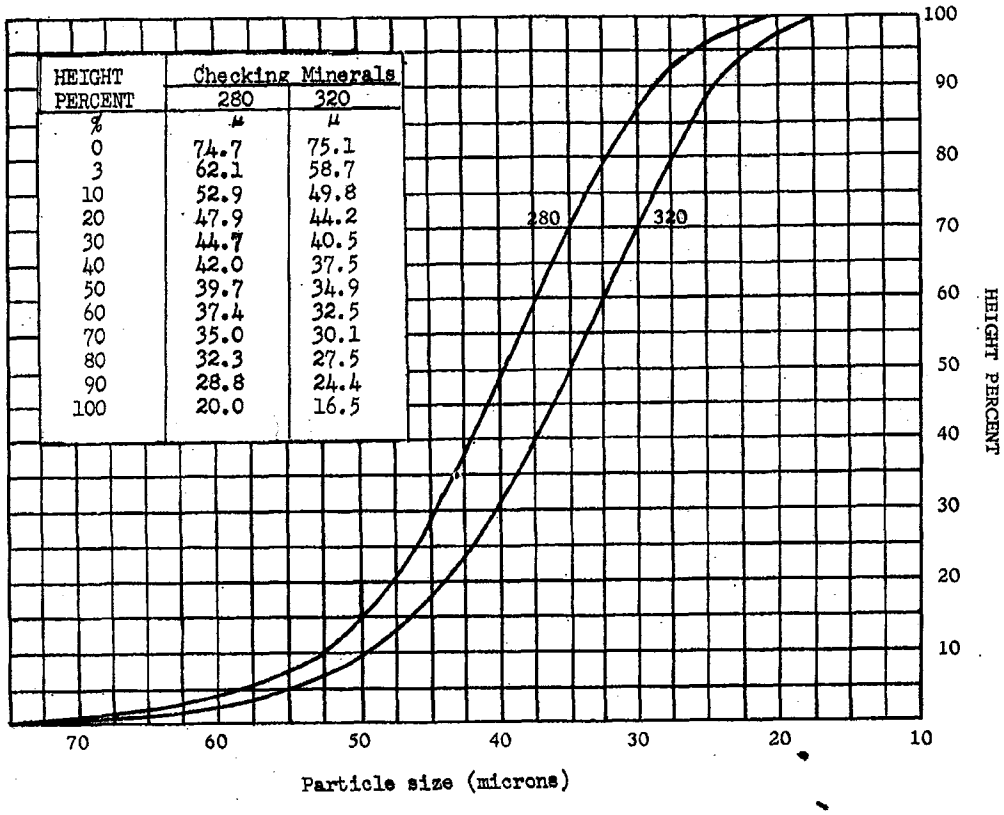

FIGURE 3. *Micron values (accumulation curves) for checking minerals for sedimentation grit sizes.*

the stack by means of the level adjusting screws in the base plate until this condition is satisfied.

The collecting tube shall be positioned inside the bottom of the sedimentation tube so that it samples the center of the sedimentation column. It should be held firmly in place by a rubber spacer located about 3 cm from the top of the tube so that eddy currents will not be set up in the sedimentation medium when the rubber stopper under the collecting tube is tapped. The sedimentation tube shall be assembled so that the column of sedimentation medium is 100 ± 0.1 cm in length.

After the apparatus has been checked for proper assembly, as outlined above, the overall accuracy of the test shall be determined by testing one or more test tube samples of the checking minerals. Overall accuracy shall be measured by a consideration of the particle sizes at 10, 20, 30, 40, and 50 percent of the total accumulated height (height-percent). The values at each of these points as read from the accumulation curves obtained by testing the checking minerals should agree within ± 0.5 micron with those obtained from the certified curves, and the average of the algebraic sum of the deviations shall not exceed ± 0.3 micron. If both of these conditions are satisfied it shall be considered that all elements of the test are as they should be, and that the size distribution of a sedimentation grit size may be determined and referred to its standard curve.

If either or both of these conditions are not satisfied, it shall be considered that the equipment is not in proper adjustment, the technique of performing the test is in error, or the sedimentation medium is of improper density and/or viscosity. The equipment shall then be rechecked and adjusted, the testing procedure shall be scrutinized and further tests shall be made with new lots of sedimentation medium and the checking minerals until the cause of the incorrect result has been determined and corrected.

6.2.5.3 **Testing technique.**—Testing shall be performed in several steps as follows:

(1) Thoroughly mix the abrasive grain to be tested by either rolling or by quartering. Place a sufficient amount of the sample in a test tube to insure 20 to 25 mm of abrasive grain in the collecting tube when it is settled. Add 15 ml of the sedimentation medium and gently work over the grain in the test tube with a standard rubber policeman until no lumps are visible in the bottom of the tube on shaking and quickly rolling the tube over into a horizontal position with the thumb held lightly over the open end of the tube. Add to the test tube two drops of the dispersing agent described in par. 6.2.3.1. Allow the abrasive grain and the sedimentation medium to remain in the test tube for at least ½ hour, and preferably for one hour, and shake the tube vigorously three times during this period. During the soaking period the temperature of the sedimentation medium in the test tube should be kept the same as that of the sedimentation medium in the sedimentation tube.

(2) Fill the sedimentation tube with sedimentation medium to a point 100 cm from the bottom of the collecting tube and allow to stand until the temperature comes to equilibrium with the temperature of the water in the water jacket surrounding the sedimentation tube. Check the temperature of the sedimentation tube, the temperature of the water in the water jacket, and the temperature of the sedimentation medium in the test tube to insure that all are the same and are within the range of 20 to 30°C.

(3) Place a seamless funnel in the top of the sedimentation tube. With the thumb held lightly over the open end of the test tube containing the abrasive grain and sedimentation medium, shake the tube vigorously for at least 30 seconds. Transfer its contents rapidly to the sedimentation tube by holding the test tube inverted with the open end level with the top of the funnel so that when the sample is released it will flow down the slope of the funnel and onto the top of the settling medium.

(4) Commence timing at the moment of transfer as the start of settling. Quickly remove the funnel from the top of the sedimentation tube to prevent any grain from dropping into the tube after settling has begun, because this will distort the results.

(5) Record the elapsed time from the start of settling to the time when the first *steady* stream of abrasive grain particles arrives at the bottom of the collecting tube. Examine the falling particles to determine if the cleaning procedure has been adequate. Agglomeration and flakes of ash indicate incorrect or inadequate grain preparation. Should such a condition exist, discard the analysis.

(6) Take each of subsequent readings of elapsed time from the start of settling as the level of the abrasive grain rises just past each of the etched graduations. Consider the end point of the determination as the time when all of the abrasive grain particles have settled, that is, when the column of grain will not rise on standing.

(7) Tap the rubber stopper at the bottom of the collecting tube gently but constantly during the time that the abrasive grain particles are falling in order to pack the particles and to keep them level, thus making accurate readings possible. For this tapping use a pencil around one end of which has been placed a 1 in. piece of rubber suction tubing. Confine the tapping of the front quarter of the rubber stopper beneath the collecting tube. No tapping should be done on the metal arm supporting the sedimentation tube, or on the collecting tube itself.

6.2.5.4 **Presentation of data.**—Table 10 shows the percent of the total accumulated height represented by each millimeter of the settled abrasive grain collected up to a total height of from 20 to 25 millimeters. Tables 11 through 14, show the effective diameter of the various particles in microns for different settling times when the sedimentation medium is at 25°C. The diameters indicated are strictly theoretical and are therefore only useful in the type of controlled test described herein.

After the various settling times have been determined, obtain from the accumulated height percent table and appropriate time-diameter table the values represented by each millimeter of abrasive grain collected and plot an accumulation curve with particle size as the abscissa and height percent as the ordinate. On the same graph and in the same way plot from the 3% point to the 50% point, the standard accumulation curves for the coated abrasive product being tested.

TABLE 10. *Accumulated height percent*

Height sedimented	Total height level of collected (sedimented) abrasive grain in millimeters										
	20	20½	21	21½	22	22½	23	23½	24	24½	25
mm	%	%	%	%	%	%	%	%	%	%	%
1	5.0	4.9	4.8	4.7	4.5	4.4	4.3	4.3	4.2	4.1	4.0
2	10.0	9.8	9.5	9.3	9.1	8.9	8.7	8.5	8.3	8.2	8.0
3	15.0	14.6	14.3	14.0	13.6	13.3	13.0	12.8	12.5	12.3	12.0
4	20.0	19.5	19.0	18.6	18.2	17.8	17.4	17.0	16.7	16.3	16.0
5	25.0	24.4	23.8	23.3	22.7	22.2	21.7	21.3	20.8	20.4	20.0
6	30.0	29.3	28.6	27.9	27.3	26.7	26.1	25.5	25.0	24.5	24.0
7	35.0	34.1	33.3	32.6	31.8	31.1	30.4	29.8	29.2	28.6	28.0
8	40.0	39.0	38.1	37.2	36.4	35.6	34.8	34.0	33.3	32.7	32.0
9	45.0	43.9	42.9	41.9	40.9	40.0	39.1	38.3	37.5	36.7	36.0
10	50.0	48.8	47.6	46.5	45.5	44.4	43.5	42.6	41.7	40.8	40.0
11	55.0	53.7	52.4	51.2	50.0	48.9	47.8	46.8	45.8	44.9	44.0
12	60.0	58.5	57.1	55.8	54.5	53.3	52.2	51.1	50.0	49.0	48.0
13	65.0	63.4	61.9	60.5	59.1	57.8	56.5	55.3	54.2	53.1	52.0
14	70.0	68.3	66.7	65.1	63.6	62.2	60.9	59.6	58.3	57.1	56.0
15	75.0	73.2	71.4	69.8	68.2	66.7	65.2	63.8	62.5	61.2	60.0
16	80.0	78.0	76.2	74.4	72.7	71.1	69.6	68.1	66.7	65.3	64.0
17	85.0	83.0	81.0	79.1	77.3	75.6	73.9	72.3	70.8	69.4	68.0
18	90.0	87.8	85.7	83.7	81.8	80.0	78.3	76.6	75.0	73.5	72.0
19	95.0	92.7	90.5	88.4	86.4	84.4	82.6	80.8	79.2	77.6	76.0
20	.....	97.6	95.2	93.0	90.9	88.9	87.0	85.1	83.3	81.6	80.0
21	.....	.....	.....	97.7	95.5	93.3	91.3	89.4	87.5	85.7	84.0
22	.....	.....	.....	.....	.....	97.8	95.7	93.6	91.7	89.8	88.0
23	.....	.....	.....	.....	.....	.....	.....	97.9	95.8	93.9	92.0
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	98.0	96.0

Sedimentation time-diameter tables for temperatures of the sedimentation medium other than 25°C, may be computed by means of the following procedure which was used in preparing Tables 11 through 14.

$$(5)\quad D=\frac{K}{\sqrt{T}}$$

Where: D=Diameter in microns
T=Settling time in minutes.

Since T is in minutes, then, at one minute:

$D=K=$ 91.1 for silicon carbide
= 79.7 for aluminum oxide
= 81.1 for garnet
=105.3 for flint.

TABLE 11. *Sedimentation time-diameter values for aluminum oxide at 25°C*

Time	Diam.	Time	Diam.	Time	Diam.	Time	Diam.
Minutes	Microns	Minutes	Microns	Minutes	Microns	Minutes	Microns
0.50	112.7	3.00	46.0	6.00	32.5	17.00	19.3
.55	107.5	.05	45.6	.10	32.3	.50	19.0
.60	102.9	.10	45.3	.20	32.0	18.00	18.8
.65	98.9	.15	44.9	.30	31.8	.50	18.5
.70	95.3	.20	44.6	.40	31.5	19.00	18.3
.75	92.0	.25	44.2	.50	31.3	.50	18.0
.80	89.1	.30	43.9	.60	31.0	20.00	17.8
.85	86.4	.35	43.5	.70	30.8	.50	17.6
.90	84.0	.40	43.2	.80	30.6	21.00	17.4
.95	81.8	.45	42.9	.90	30.3	22.00	17.0
1.00	79.7	.50	42.6	7.00	30.1	23.00	16.6
.05	77.8	.55	42.3	.10	29.9	24.00	16.3
.10	76.0	.60	42.0	.20	29.7	25.00	15.9
.15	74.3	.65	41.7	.30	29.5	26.00	15.6
.20	72.8	.70	41.4	.40	29.3	27.00	15.3
.25	71.3	.75	41.2	.50	29.1	28.00	15.1
.30	69.9	.80	40.9	.60	28.9	29.00	14.8
.35	68.6	.85	40.6	.70	28.7	30.00	14.6
.40	67.4	.90	40.4	.80	28.5	32.00	14.1
.45	66.2	.95	40.1	.90	28.4	34.00	13.7
.50	65.1	4.00	39.8	8.00	28.2	36.00	13.3
.55	64.0	.05	39.6	.20	27.8	38.00	12.9
.60	63.0	.10	39.4	.40	27.5	40.00	12.6
.65	62.0	.15	39.1	.60	27.2	42.00	12.3
.70	61.1	.20	38.9	.80	26.9	44.00	12.0
.75	60.2	.25	38.7	9.00	26.6	46.00	11.8
.80	59.4	.30	38.4	.20	26.3	48.00	11.5
.85	58.6	.35	38.2	.40	26.0	50.00	11.3
.90	57.8	.40	38.0	.60	25.7	55.00	10.8
.95	57.1	.45	37.8	.80	25.5	60.00	10.3
2.00	56.4	.50	37.6	10.00	25.2		
.05	55.7	.55	37.4	.20	25.0		
.10	55.0	.60	37.2	.40	24.7		
.15	54.4	.65	37.0	.60	24.5		
.20	53.7	.70	36.8	.80	24.2		
.25	53.1	.75	36.6	11.00	24.0		
.30	52.6	.80	36.4	.20	23.8		
.35	52.0	.85	36.2	.40	23.6		
.40	51.4	.90	36.0	.60	23.4		
.45	50.9	.95	35.8	.80	23.2		
.50	50.4	5.00	35.6	12.00	23.0		
.55	49.9	.10	35.3	.50	22.5		
.60	49.4	.20	35.0	13.00	22.1		
.65	49.0	.30	34.6	.50	21.7		
.70	48.5	.40	34.3	14.00	21.3		
.75	48.1	.50	34.0	.50	20.9		
.80	47.6	.60	33.7	15.00	20.6		
.85	47.2	.70	33.4	.50	20.2		
.90	46.8	.80	33.1	16.00	19.9		
.95	46.4	.90	32.8	.50	19.6		

Calculation of K:

Constant $K = 20{,}000 \sqrt{\frac{9nL}{2g(p-d)60}}$

Where: $n =$ 0.00656 at 25°C
$L = 100$
$g = 980$
$p =$ 3.22 for silicon carbide
$=$ 3.96 for aluminum oxide
$=$ 3.85 for garnet
$=$ 2.61 for flint
$d =$ 0.800 at 25°C.

At other settling medium temperatures between 20 and 30°C, the 25°C value of K may be corrected as follows:

K for silicon carbide $= 109.6 - 0.741 \times t$
K for aluminum oxide $= 96.16 - 0.657 \times t$
K for garnet $= 98.0 - 0.675 \times t$
K for flint $= 127.1 - 0.871 \times t$
Where: t = temperature in degrees Celsius.

TABLE 12. *Sedimentation time-diameter values for silicon carbide at 25°C*

Time	Diam.	Time	Diam.	Time	Diam.	Time	Diam.
Minutes	Microns	Minutes	Microns	Minutes	Microns	Minutes	Microns
0.50	128.8	3.00	52.6	6.00	37.2	17.00	22.1
.55	122.8	.05	52.2	.10	36.9	.50	21.8
.60	117.6	.10	51.7	.20	36.6	18.00	21.5
.65	112.9	.15	51.3	.30	36.3	.50	21.2
.70	108.8	.20	50.9	.40	36.0	19.00	20.9
.75	105.1	3.25	50.5	6.50	35.7	.50	20.6
.80	101.8	.30	50.2	.60	35.5	20.00	20.4
.85	98.8	.35	49.8	.70	35.2	.50	20.1
.90	96.0	.40	49.4	.80	34.9	21.00	19.9
.95	93.4	.45	49.0	.90	34.7	22.00	19.4
1.00	91.1	3.50	48.7	7.00	34.4	23.00	19.0
.05	88.9	.55	48.4	.10	34.2	24.00	18.6
.10	86.9	.60	48.0	.20	34.0	25.00	18.2
.15	85.0	.65	47.7	.30	33.7	26.00	17.9
.20	83.2	.70	47.4	.40	33.5	27.00	17.5
1.25	81.5	3.75	47.0	7.50	33.3	28.00	17.2
.30	79.9	.80	46.7	.60	33.0	29.00	16.9
.35	78.4	.85	46.4	.70	32.8	30.00	16.6
.40	77.0	.90	46.1	.80	32.6	32.00	16.1
.45	75.6	.95	45.8	.90	32.4	34.00	15.6
1.50	74.4	4.00	45.6	8.00	32.2	36.00	15.2
.55	73.2	.05	45.3	.20	31.8	38.00	14.8
.60	72.0	.10	45.0	.40	31.4	40.00	14.4
.65	70.9	.15	44.7	.60	31.1	42.00	14.0
.70	69.9	.20	44.4	.80	30.7	44.00	13.7
1.75	68.9	4.25	44.2	9.00	30.4	46.00	13.4
.80	67.9	.30	43.9	.20	30.0	48.00	13.1
.85	67.0	.35	43.7	.40	29.7	50.00	12.9
.90	66.1	.40	43.4	.60	29.4	55.00	12.3
.95	65.2	.45	43.2	.80	29.1	60.00	11.8
2.00	64.4	4.50	42.9	10.00	28.8		
.05	63.6	.55	42.7	.20	28.5		
.10	62.9	.60	42.5	.40	28.2		
.15	62.1	.65	42.2	.60	28.0		
.20	61.4	.70	42.0	.80	27.7		
2.25	60.7	4.75	41.8	11.00	27.5		
.30	60.1	.80	41.6	.20	27.2		
.35	59.4	.85	41.4	.40	27.0		
.40	58.8	.90	41.2	.60	26.7		
.45	58.2	.95	40.9	.80	26.5		
2.50	57.6	5.00	40.7	12.00	26.3		
.55	57.0	.10	40.3	.50	25.8		
.60	56.5	.20	40.0	13.00	25.3		
.65	56.0	.30	39.6	.50	24.8		
.70	55.4	.40	39.2	14.00	24.3		
2.75	54.9	5.50	38.8	.50	23.9		
.80	54.4	.60	38.5	15.00	23.5		
.85	54.0	.70	38.2	.50	23.1		
.90	53.5	.80	37.8	16.00	22.8		
.95	53.0	.90	37.5	.50	22.4		

TABLE 13. *Sedimentation time-diameter values for garnet at 25°C*

Time	Diam.	Time	Diam.	Time	Diam.	Time	Diam.
Minutes	Microns	Minutes	Microns	Minutes	Microns	Minutes	Microns
0.50	114.7	3.00	46.8	6.00	33.1	17.00	19.7
.55	109.4	.05	46.4	.10	32.8	.50	19.4
.60	104.7	.10	46.1	.20	32.6	18.00	19.1
.65	100.6	.15	45.7	.30	32.3	.50	18.8
.70	96.9	.20	45.3	.40	32.0	19.00	18.6
.75	93.6	.25	45.0	.50	31.8	.50	18.4
.80	90.7	.30	44.6	.60	31.6	20.00	18.1
.85	88.0	.35	44.3	.70	31.3	.50	17.9
.90	85.5	.40	44.0	.80	31.1	21.00	17.6
.95	83.2	.45	43.7	.90	30.9	22.00	17.3
1.00	81.1	.50	43.4	7.00	30.6	23.00	16.9
.05	79.2	.55	43.0	.10	30.4	24.00	16.6
.10	77.3	.60	42.7	.20	30.2	25.00	16.2
.15	75.6	.65	42.5	.30	30.0	26.00	15.9
.20	74.0	.70	42.2	.40	29.8	27.00	15.6
.25	72.5	.75	41.9	.50	29.6	28.00	15.3
.30	71.1	.80	41.6	.60	29.4	29.00	15.1
.35	69.8	.85	41.3	.70	29.2	30.00	14.8
.40	68.5	.90	41.1	.80	29.0	32.00	14.3
.45	67.4	.95	40.8	.90	28.8	34.00	13.9
.50	66.2	4.00	40.6	8.00	28.7	36.00	13.5
.55	65.1	.05	40.3	.20	28.3	38.00	13.2
.60	64.1	.10	40.0	.40	28.0	40.00	12.8
.65	63.1	.15	39.8	.60	27.6	42.00	12.5
.70	62.2	.20	39.6	.80	27.3	44.00	12.2
.75	61.3	.25	39.3	9.00	27.0	48.00	11.7
.80	60.4	.30	39.1	.20	26.7	50.00	11.5
.85	59.6	.35	38.9	.40	26.4	55.00	10.9
.90	58.8	.40	38.7	.60	26.2	60.00	10.5
.95	58.1	.45	38.4	.80	25.9		
2.00	57.3	.50	38.2	10.00	25.6		
.05	56.6	.55	38.0	.20	25.4		
.10	56.0	.60	37.8	.40	25.1		
.15	55.3	.65	37.6	.60	24.9		
.20	54.7	.70	37.4	.80	24.7		
.25	54.1	.75	37.2	11.00	24.4		
.30	53.5	.80	37.0	.20	24.2		
.35	52.9	.85	36.8	.40	24.0		
.40	52.4	.90	36.6	.60	23.8		
.45	51.8	.95	36.4	.80	23.6		
.50	51.3	5.00	36.3	12.00	23.4		
.55	50.8	.10	35.9	.50	22.9		
.60	50.3	.20	35.6	13.00	22.5		
.65	49.8	.30	35.2	.50	22.1		
.70	49.4	.40	34.9	14.00	21.7		
.75	48.9	.50	34.6	.50	21.3		
.80	48.5	.60	34.3	15.00	21.0		
.85	48.0	.70	34.0	.50	20.6		
.90	47.6	.80	33.7	16.00	20.3		
.95	47.2	.90	33.4	.50	20.0		

7. CERTIFICATION

7.1 **Certification of shipments.**—In order to assure the purchaser of coated abrasive products that he is getting products in which the abrasive grain sizing is quality controlled to conform to the testing requirements of this Product Standard, producers are urged individually, or in concert with their trade associations, to mark containers of each product complying herewith by stamp, brand, or label and to certify invoices for each shipment. The following uniform certification statement is recommended for the invoice:

> The grit size of the abrasive grain on the coated abrasive products in this shipment complies with all the size grading requirements of Product Standard PS8–67, as developed under the voluntary standards procedures of the National Bureau of Standards, U. S. Department of Commerce.

Grit size and abrasive

Name of manufacturer

TABLE 14. *Sedimentation time-diameter values for flint at 25°C*

Time	Diam.	Time	Diam.	Time	Diam.	Time	Diam	Time	Diam.
Minutes	Microns	Minutes	Microns	Minutes	Microns	Minutes	Microns	Minutes	Microns
0.50	148.9	2.90	61.8	5.30	45.7	9.30	34.5	34.00	18.0
.55	141.9	.95	61.3	.35	45.5	.40	34.3	35.00	17.8
.60	135.9	3.00	60.8	.40	45.3	.50	34.2	36.00	17.6
.65	130.6	.05	60.3	.45	45.1	.60	34.0	37.00	17.3
.70	125.8	.10	59.8	5.50	44.9	.70	33.8	38.00	17.1
.75	121.5	.15	59.3	.55	44.7	.80	33.6	39.00	16.9
.80	117.7	.20	58.9	.60	44.5	.90	33.5	40.00	16.6
.85	114.2	.25	58.4	.65	44.3	10.00	33.3	41.00	16.4
.90	111.0	.30	58.0	.70	44.1	.20	33.0	42.00	16.2
.95	108.0	.35	57.5	.75	43.9	.40	32.6	43.00	16.1
1.00	105.3	.40	57.1	.80	43.7	.60	32.3	44.00	15.9
.05	102.7	.45	56.7	.85	43.5	.80	32.0	45.00	15.7
.10	100.4	.50	56.3	.90	43.4	11.00	31.7	46.00	15.5
.15	98.2	.55	55.9	.95	43.2	.20	31.5	47.00	15.4
.20	96.1	.60	55.5	6.00	43.0	.40	31.2	48.00	15.2
.25	94.2	.65	55.1	.05	42.8	.60	30.9	49.00	15.0
.30	92.4	.70	54.7	.10	42.6	.80	30.6	50.00	14.9
.35	90.6	.75	54.4	.20	42.3	12.00	30.4	55.00	14.2
.40	89.0	.80	54.0	.30	42.0	.50	29.8	60.00	13.6
.45	87.4	.85	53.7	.40	41.6	13.00	29.2	65.00	13.1
.50	86.0	.90	53.3	.50	41.3	.50	28.6	70.00	12.6
.55	84.6	.95	53.0	.60	41.0	14.00	28.1	75.00	12.2
.60	83.2	4.00	52.6	.70	40.7	.50	27.6	80.00	11.8
.65	82.0	.05	52.3	.80	40.4	15.00	27.2	85.00	11.4
.70	80.8	.10	52.0	.90	40.1	.50	26.7	90.00	11.1
.75	79.6	.15	51.7	7.00	39.8	16.00	26.3	95.00	10.8
.80	78.5	.20	51.4	.10	39.5	.50	25.9	100.00	10.5
.85	77.4	.25	51.1	.20	39.2	17.00	25.5	110.00	10.0
.90	76.4	.30	50.8	.30	39.0	.50	25.2	120.00	9.6
.95	75.4	.35	50.5	.40	38.7	18.00	24.8	130.00	9.2
2.00	74.4	.40	50.2	.50	38.4	.50	24.5	140.00	8.9
.05	73.5	.45	49.9	.60	38.2	19.00	24.2	150.00	8.6
.10	72.7	.50	49.6	.70	37.9	.50	23.8	160.00	8.3
.15	71.8	.55	49.4	.80	37.7	20.00	23.5		
.20	71.0	.60	49.1	.90	37.5	.50	23.2		
.25	70.2	.65	48.8	8.00	37.2	21.00	23.0		
.30	69.4	.70	48.6	.10	37.0	22.00	22.4		
.35	68.7	.75	48.3	.20	36.8	23.00	22.0		
.40	68.0	.80	48.1	.30	36.6	24.00	21.5		
.45	67.3	.85	47.8	.40	36.3	25.00	21.1		
.50	66.6	.90	47.6	.50	36.1	26.00	20.6		
.55	65.9	.95	47.3	.60	35.9	27.00	20.3		
.60	65.3	5.00	47.1	.70	35.7	28.00	19.9		
.65	64.7	.05	46.8	.80	35.5	29.00	19.6		
.70	64.1	.10	46.6	.90	35.3	30.00	19.2		
.75	63.5	.15	46.4	9.00	35.1	31.00	18.9		
.80	62.9	.20	46.2	.10	34.9	32.00	18.6		
.85	62.4	.25	46.0	.20	34.7	33.00	18.3		

7.2 **Item identification.**—Products of each grit size complying with this Standard may be identified with the symbol of the standard, "PS8–67", the name of the manufacturer, the grit size, and the type of abrasive grain.

STANDING COMMITTEE

The following individuals comprise the membership of the Standing Committee which is to review, prior to circulation for acceptance, revisions proposed to keep this Standard abreast of progress. Comment concerning the Standard and suggestions for revision may be addressed to any member of the Committee or the Product Standards Section, National Bureau of Standards, U. S. Department of Commerce, which acts as secretary for the committee.

Representing abrasive grain producers:

Edward W. Bratton, Coated Abrasives Division, The Carborundum Co., P.O. Box 477, Niagara Falls, N. Y. 14302 (Chairman)

V. W. Gilbert, Behr-Manning, Division of Norton Co., P.O. Drawer 808, Troy, N. Y. 12181
H. H. Barton, President, Barton Mines Corporation, Gore Mt. Rd., North Creek, N. Y. 12853

Representing coated abrasive product producers (grain users):
Richard P. Villwock, Michigan Abrasive Co., 11900 East Eight Mile Rd., Detroit, Mich. 48205
S. W. Thiele, Coated Abrasives and Related Products Division, 3M Co., 2501 Hudson Rd., St. Paul, Minn. 55119
Ira Hoffman, Tennessee Sandpaper Corp., 103 Fern Ave., Nashville, Tenn. 37207

Representing distributors:
Eugene C. Roser, The Abrasive Machine and Supply Co., 261 South St., Newark, N. J. 07114
C. S. Adams, Pittsburgh Gage and Supply Co., 3000 Liberty Ave., Pittsburgh, Pa. 15201
Richard M. Wright, Kasco Abrasives, Inc., 3461 E 26th St., Los Angeles, Calif. 90023

Representing users of coated abrasive products:
Wm. T. Tiffin, Prof., Department of Metallurgy, College of Engineering, University of Florida, Gainesville, Fla. 32601
John Carroll, Materials Evaluation Department, U. S. Testing Co., 1415 Park Avenue, Hoboken, N. J. 07030
John Y. Arnold, Carpenter Steel Co., 101 W. Bern St., Reading, Pa. 19603

HISTORY OF PROJECT

First edition:

The cooperation of the Commodity Standards Division (now Product Standards Section) in establishing a Commercial Standard for the Grading of the abrasive grain used on abrasive coated sheets, belts, discs, rolls and similar products, was requested by the Coated Abrasive Manufacturers' Institute on June 27, 1957. After review by the National Bureau of Standards, a draft submitted by the Institute was modified, and a proposed Commercial Standard was mailed to all manufacturers and to selected users, testing laboratories, and Government agencies on May 5, 1958, for advance comment. Further minor adjustments were made and a Recommended Commercial Standard was widely circulated to producers, distributors, users, and testing laboratories for consideration and final approval on November 26, 1958. Sufficient endorsements in the form of signed acceptances from individual organizations were received to insure the successful application of the new standard. Accordingly the establishment of Commercial Standard CS217–59, Grading of Abrasive Grain on Coated Abrasive Products, was announced on February 18, 1959, to be effective for new production from March 18, 1959.

Current revisions:

On August 7, 1964, the Coated Abrasive Manufacturers Institute requested a revision of CS217–59, and submitted a list of the suggested changes. Additional suggestions were offered by the National Bureau of Standards. A Proposed Revision of the Standard, TS–5674, was distributed to all producers of abrasive grain and of coated abrasive products, to the Standing Committee, and to testing laboratories for consideration. Minor adjustments were made based on the comment received, and on August 10, 1966, a Recommended Product Standard was widely distributed to the industry for acceptance. A public notice was issued to the technical trade press.

Endorsements in the form of signed acceptance sheets were received from individual producers who represented, according to the CAMI, approximately 90% of the abrasive grain, and of the coated abrasive product production. Many coated abrasive product distributors, users, testing laboratories, and government interests also filed acceptances (see List of Acceptors as printed herein). These endorsements were considered to represent a reasonable consensus, and there were no objections to the proposal. Accordingly, the approval for publication of Product Standard PS8–67 for Grading of Abrasive Grain on Coated Abrasive Products, was announced on December 9, 1966, to become effective for new production on January 9, 1967.

The principal changes made in this edition are, (1) the establishment of a single set of standard accumulation curves for all waterproof and non-waterproof sedimentation sizes of abrasive grain, (2) the establishment of grading limits for both screen and sedimentation grit sizes of flint (pouncing paper) and flint (snuffing paper), and (3) making the grading limits for the sedimentation sizes of flint (finishing paper) consistent with those of the other abrasive grains. The full range of grit sizes for garnet are also included.

Project Manager: Wm. H. Furcolow, Product Standards Section, Office of Engineering Standards Services, National Bureau of Standards.

ACCEPTORS

The manufacturers, distributors, users and others listed below have individually indicated in writing their acceptance of this Product Standard prior to its publication. The acceptances indicate an intention to utilize the standard as far as practicable, but reserve the right to depart from it as may be deemed desirable. The list is published to show the extent of recorded public support for the standard, and should not be construed as indicating that all products made by the acceptors actually comply with its requirements.

Products that meet all requirements of the standard may be identified as such by a certificate, grade mark, or label. Purchasers are encouraged to require such specific evidence of compliance, which may be given by the manufacturer whether or not he is listed as an acceptor.

ASSOCIATIONS
(General Support)

Abrasive Grain Association, Cleveland, Ohio
American Society For Abrasive Methods, Chicago, Ill.
American Society of Tool and Manufacturing Engineers, Dearborn, Mich.
Automobile Manufacturers Association, Indianapolis, Indiana
Coated Abrasive Manufacturers' Institute, New York, N. Y.

PRODUCERS

Abrasive Materials, Inc., Hillsdale, Michigan
Abrasive Products Co., Lansdowne, Pa.
Abrasive Products, Inc., South Braintree, Mass.
American Abrasive Co., Westfield, Mass.
Amplex Corp., Bloomfield, Conn.
Armour Abrasives Co., a Division of Armour & Co., Alliance, Ohio
Arolox, Inc., Ypsilanti, Mich.
Barton Mines Corp., North Creek, N. Y.

Bates Abrasive Products, Inc., Chicago, Ill.
Behr-Manning, Division of Norton Co., Troy, N. Y.
Bruce Products Corp., Howell, Mich.
Cabot Corporation, Boston, Mass.
Carbide Products Co., Huntington Park, Calif.
Carborundum Co., Coated Abrasives Division, Niagara Falls, N. Y.
Carborundum Co., Electro Minerals Division, Niagara Falls, N. Y.
Clover Manufacturing Co., Norwalk, Conn.
Dessau, Maurice S., Co., Inc., New York, N. Y.
Diamond Dust Co., Inc., Mineola, N. Y.
Exolon Co., Tonawanda, N. Y.
General Abrasive Co., Inc., Niagara Falls, N. Y.
Merit Products, Los Angeles, Calif.
Michigan Abrasive Co., Detroit, Mich.
Micro Abrasives Corp., Westfield, Mass.
Mid-West Abrasive Co., Owosso, Mich.
Minnesota Mining and Manufacturing Co., St. Paul, Minn.
Norton Co., Worcester, Mass.
Penn Scientific Products Co., Inc., Abington, Pa.
Raybestos-Manhattan, Inc., Passaic, N. J.
Sandpaper, Inc., Rockland, Mass.
Simonds Abrasive Co., Philadelphia, Pa.
Simonds Canada Saw Co., Grinding Wheel Division, LTD, Brockville, Ontario, Canada
Tennessee Sandpaper Corp., Nashville, Tenn.
Washington Mills Abrasive Co., North Grafton, Mass.

DISTRIBUTORS

Abrasive Machine & Supply Co., Newark, N. J.
Almquist Tool & Equipment Co., Los Angeles, Calif.
Amarillo Hardware Co., Amarillo, Tex.
Atlantic Abrasive Corp., South Braintree, Mass.
Babcock, Hinds & Underwood, Inc., Binghamton, N. Y.
Barrett Hardware Co., Joliet, Ill.
Behn, H. J., & Co., Inc., Fairfield, Conn.
Bittenbender Co., Scranton, Pa.
Bond Supply Co., Kalamazoo, Mich.
Carey Machinery & Supply Co., Inc., Baltimore, Md.
Church & Morse, Inc., Meriden, Conn.
Clifford-Rockwell, Co., Detroit, Mich.
Coffeyville Mill Supply Co., Coffeyville, Kans.
Colonial Hardware Co., New York, N. Y.
Colonial Supply Co., Pittsburgh, Pa.
Daly, A. B., & Co., Coos Bay, Oreg.
Danser Hardware & Supply Co., Weston, W. Va.
Despard, F. F., Co., Inc., Utica, N. Y.
Diamond Specialty & Supply Co., Inc., Philadelphia, Pa.
Ducommun Metals & Supply Co., Los Angeles, Calif.
Edwards & Walker Co., Portland, Maine
Ellsworth Industrial Supply Co., Stratford, Conn.
Erie Manufacturing & Supply Corp., Erie, Pa.
Franke, C. D., & Co., Inc., Charleston, S. C.
Fulton Supply Co., Atlanta, Ga.
Garnich, E., & Sons Hardware Co., Ashland, Wis.
Gastonia Mill Supply Co., Gastonia, N. C.
Gerard Kluyskens Co., New York, N. Y.
Globe Machinery & Supply Co., Des Moines, Iowa
Gondas Corp., Miami, Fla.
Grand Rapids Supply Co., Grand Rapids, Mich.
Hardware Supply Co., Inc., Terre Haute, Ind.
Harper Supply Co., Jackson, Miss.
Hart Industrial Supply Co., Oklahoma City, Okla.
Haverstick & Co., Inc., Rochester, N. Y.
Heller, J., & Sons, Newark, N. J.
Herzog Supply Co., Inc., Kingston, N. Y.
Hickinbotham Bros., Ltd., Stockton, Calif.
Holcomb, A. L., Co., Grand Rapids, Mich.
Hyman Supply Co., Wilmington, N. C.
Iding, M. P., Disc Grinding Compound Co., Inc., Milwaukee, Wis.
Indiana Manufacturers Supply Co., Inc., Indianapolis, Ind.
Industrial Supply Co., Terre Haute, Ind.
Jennison Hardware Co., Bay City, Mich.
Kasco Abrasives, Inc., Los Angeles, Calif.
Klem Supply, Inc., Elkhart, Ind.
Lee Hardware Co., Salina, Kans.
Lewis Supply Co., Inc., Memphis, Tenn.
Lubbock Hardware & Supply Co., Inc., Lubbock, Tex.
Machinists' Tool & Supply Co., Los Angeles, Calif.
Maguire & McLernon, Inc., Baltimore, Md.
Mansfield Hardware & Supply Co., Mansfield, Ohio
Mark Twain Supply Co., Hannibal, Mo.
Millar Supply, Inc., Utica, N. Y.
Millers Falls Co., Greenfield, Mass.
Miller Hardware Co., Inc., Jersey City, N. J.
New Jersey Engineering & Supply Co., Passaic, N. J.
Pacific Abrasive Supply Co., Los Angeles, Calif.
Papke, K. J., Co., Inc., Milwaukee, Wis.
Percival Steel & Supply Co., Vernon, Calif.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Raleigh Hardware Co., Inc., Mabscott, W. Va.
Reichle Supply Co., Saginaw, Mich.
Rex Supply Corp., Houston, Tex.
Reynolds, W. L., Co., Baltimore, Md.
Riel Hardware & Mill Supply, Inc., Springfield, Mass.
Rockford Tool & Transmission Co., Rockford, Ill.
Rogers-Bailey Supply Co., Chattanooga, Tenn.
Ross-Frazer Supply Co., St. Joseph, Mo.
Sager Spuck Supply Co., Inc., Albany, N. Y.
Smith, W. H., Hardware Co., Parkersburg, W. Va.
Squier, Schilling & S. Kiff, Newark, N. J.
Syracuse Supply Co., Inc., Syracuse, N. Y.
Tracy, Robinson & Williams Co., Hartford, Conn.
Troy Belting & Supply Co., Troy, N. Y.
United Mineral & Chemical Corp., New York, N. Y.
United States Grinding Wheel Co., Inc., New York, N. Y.
Universal Shellac & Supply Co., Inc., Brooklyn, N. Y.
Ward Brothers Mill Supply Co., Inc., Lockport, N. Y.
Western Iron Stores Co., Milwaukee, Wis.
Wiley-Hughes Supply Co., Trenton, N. J.
Wing, R. B., & Son, Corp., Albany, N. Y.
Woodward, Wight & Co., LTD, New Orleans, La.

USERS

Acroscope Engineering, Inc., Los Angeles, Calif.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Coldset Corp., Teterboro, N. J.
Bancroft, Frank, Co., Inc., Dearborn, Mich.
Bower Roller Bearing Division, Federal Mogul Corp., Detroit, Mich.
Cardwell Machine Co., Richmond, Va.
Carpenter Steel Co., Reading, Pa.
Chicago, Milwaukee, St. Paul & Pacific Railroad Co., Milwaukee, Wis.
Chicago Wheel & Manufacturing Co., Chicago, Ill.

Cleveland Twist Drill Co., Cleveland, Ohio
Columbian Vise & Manufacturing Co., Cleveland, Ohio
Cratex Manufacturing Co., Inc., Burlingame, Calif.
Denver & Rio Grande Western Railroad, Denver, Colo.
Detroit Toledo & Ironton RR Co., Dearborn, Mich.
Dresser Manufacturing Division, Bradford, Pa.
Dyna Corp., Dayton, Ohio
Edmar Abrasive Co., Andalusia, Pa.
Enderes Tool Co., Inc., Albert Lea, Minn.
Erie Lackawanna Railroad Co., Cleveland, Ohio
Firth Sterling, Inc., Pittsburgh, Pa.
University of Florida, Gainesville, Fla.
General Grinding Wheel Corp., Carlisle, Pa.
General Motors Corp., Warren, Mich.
Industries, H. M., Inc., Rochester, N. Y.
Hoskins Manufacturing Co., Detroit, Mich.
Hypro Tool Co., New Bedford, Mass.
Industrial Tool Sales & Service, Cicero, Ill.
Inland Steel Co., East Chicago, Ind.
Internal Grinding Abrasives, Inc., Grand Rapids, Mich.
International Harvester Co., Manufacturing Research, Chicago, Ill.
Nesen Diamond Tool Corporation, Tuckahoe, N. Y.
New Process Gear Division, Chrysler Corp., East Syracuse, N. Y.
Norfolk & Western Railway Co., Roanoke, Va.
Northern Pacific Railway Co., St. Paul, Minn.
Precision Diamond Tool Co., Elgin, Ill.
S K F Industries, Inc., Timonium, Md.
Simmons Co., Elizabeth, N. J.
Sterling Grinding Wheel Co., Subsidiary of ITT Wakefield Corp., Tiffin, Ohio
Super-cut, Inc., Chicago, Ill.
Tennessee Central Railway Co., Nashville, Tenn.
Union Pacific R. R. Co., Omaha, Nebr.
Westfield Grinding Wheel Co., Westfield, Mass.
Wheel Trueing Tool Co., Detroit, Mich.

TESTING LABORATORIES

American Standards Testing Bureau, Inc., New York, N. Y.
Avco Bay State Abrasive Division, Westboro, Mass.
Bowser-Morner Testing Laboratories, Inc., Dayton, Ohio
Commercial Testing & Engineering Co., Chicago, Ill.
Conwell, E. L., & Co., Philadelphia, Pa.
Froehling & Robertson, Inc., Richmond, Va.
Illinois Institute of Technology, Research Institute, Ceramics Division, Chicago, Ill.
McCreath, Andrew S., & Son, Inc., Harrisburg, Pa.
Mineral Industry Research Laboratory, College, Alaska
Newark Wire Cloth Co., Newark, N. J.
Patzig Testing Laboratories, Inc., Des Moines, Iowa
Penniman & Browne, Inc., Baltimore, Md.
Pitkin, Lucius, Inc., New York, N. Y.
Shilstone Testing Laboratory, Inc., New Orleans, La.

OTHER INTERESTS

Action Diamond Tool Co., Chicago, Ill.
Diamond, M. K., Products, Hawthorne, Calif.
Flack-Pennell Co., Saginaw, Mich.
Ford Tool & Carbide Co., Birmingham, Ala.
Fortune Industries, Inc., Chelsea, Mich.
Grinding & Polishing Machinery Corp., Indianapolis, Ind.
Hallock, F., Co., Derby, Conn.
Hanson Co., Ferndale, Detroit, Mich.
Ideal Industries, Inc., Sycamore, Ill.
Keith-Simmons Co., Inc., Nashville, Tenn.
Tools & Abrasives, Inc., Milwaukee, Wis.
Van Horn, Oliver H., Co., Inc., Baton Rouge, La.
Virginia Engineering and Research Co., Colonial Heights, Va.
Warren Diamond Powder Co., College Point, N. Y.

U. S. GOVERNMENT

Air Force, Department of, Chemical & Corrosion Branch, Warner Robbins, Ga.
District of Columbia, Procurement Office. Washington, D. C.
Federal Prison Industries, Inc., Washington, D. C.
Interior, Department of the, Division of Property & Records, Office of the Secretary, Washington, D.C.

LOCAL GOVERNMENT

Boston, City of, Purchasing Division, Boston, Mass.