INTERNATIONAL STANDARD

ISO 8486-2

Second edition
2007-08-01

Bonded abrasives — Determination and designation of grain size distribution —

Part 2: Microgrits F230 to F2000

Abrasifs agglomérés — Détermination et désignation de la distribution granulométrique —

Partie 2: Micrograins F230 à F2000

Reference number
ISO 8486-2:2007(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8486-2 was prepared by Technical Committee ISO/TC 29, *Small tools*, Subcommittee SC 5, *Grinding wheels and abrasives*.

This second edition cancels and replaces the first edition (ISO 8486-2:1996), which has been technically revised.

ISO 8486 consists of the following parts, under the general title *Bonded abrasives — Determination and designation of grain size distribution*:

— *Part 1: Macrogrits F4 to F220*

— *Part 2: Microgrits F230 to F2000*

Bonded abrasives — Determination and designation of grain size distribution —

Part 2:
Microgrits F230 to F2000

1 Scope

This part of ISO 8486 sets forth a method for determining or checking the size distribution of microgrits F230 to F2000 in fused aluminium oxide and silicon carbide.

It specifies the grit designation for the testing of those grits used in the manufacture of bonded abrasive products and general industrial applications and those removed from bonded products, as well as loose grits used in polishing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8486-1, *Bonded abrasives — Determination and designation of grain size distribution — Part 1: Macrogrits F4 to F220*

3 Terms and definitions

For the purposes of this document, terms and definitions given in ISO 8486-1 and the following apply.

3.1
microgrits
grits with grain size distributions that are determined by sedimentation and mean grain sizes (d_{s50}) of 60 µm or less

4 Method of checking grain size distribution

4.1 Grain size distribution

The grain size distribution of microgrits F230 to F2000 is determined according to the following criteria:

a) the grain size (theoretical grain diameter) shall not exceed the maximum permissible d_{s3} value at the 3 % point of the grain size distribution curve;

b) the median size (theoretical grain diameter) shall be within the specified tolerances of the d_{s50} value at the 50 % point of the grain size distribution curve;

c) the grain size (theoretical grain diameter) shall attain at least the d_{s80}, $d_{s94/95}$ values at the 80 % and 94/95 % points of the grain size distribution curve.

The three criteria shall be met simultaneously. The values are specified in Table 1 for a photosedimentometer (94 %) and in Table 2 for a US sedimentation tube (95 %).

The testing of microgrits F230 to F2000 is to be carried out by sedimentation according to Clause 5.

Table 1 — Grain size distribution of microgrits F230 to F2000 based on photosedimentometer and mastergrits (see 6.1)

Grit designation	d_{s3} value max. µm	Median grain size d_{s50} value µm	d_{s80} value min. µm	d_{s94} value min. µm
F230	82	53 ± 3	—	34
F240	70	44,5 ± 2	—	28
F280	59	36,5 ± 1,5	—	22
F320	49	29,2 ± 1,5	—	16,5
F360	40	22,8 ± 1,5	—	12
F400	32	17,3 ± 1	—	8
F500	25	12,8 ± 1	—	5
F600	19	9,3 ± 1	—	3
F800	14	6,5 ± 1	—	2
F1000	10	4,5 ± 0,8	—	1
F1200	7	3 ± 0,5	1	—
F1500	5	2 ± 0,4	0,8	—
F2000	3,5	1,2 ± 0,3	0,5	—

Table 2 — Grain size distribution of microgrits F230 to F1200 based on US sedimentation tube and checking minerals

Grit designation	d_{s3} value max. µm	Median grain size d_{s50} value µm	d_{s80} value min. µm	d_{s95} value min. µm
F230	77	55,7 ± 3	—	38
F240	68	47,5 ± 2	—	32
F280	60	39,9 ± 1,5	—	25
F320	52	32,8 ± 1,5	—	19
F360	46	26,7 ± 1,5	—	14
F400	39	21,4 ± 1	—	10
F500	34	17,1 ± 1	—	7
F600	30	13,7 ± 1	—	4,6
F800	26	11 ± 1	—	3,5
F1000	23	9,1 ± 0,8	—	2,4
F1200	20	7,6 ± 0,5	2,4	—

NOTE These values were calculated based on ISO round-robin tests.

4.2 Grading

The F series is a graduated series of thirteen microgrits, starting at a median particle size of 53 µm and ending at 1,2 µm, as determined by a photosedimentometer. This series follows on from the finest grain in the F series macrogrits F220 (63 µm) and uses the same ratio as that series, i.e. $\sqrt[4]{2}$.

The calculation of the individual grain size values (see Table 3) has been made as follows:

a) the ratio of the median grain sizes F230 and F240 is $\sqrt[4]{2} \cdot f^{0}$, i.e. it corresponds approximately to the progressive ratio of the test sieves for macrogrits;

b) the ratio of the median grain sizes of the following grits F240 and F280 is $\sqrt[4]{2} \cdot f^{1}$;

c) the ratio of the succeeding grain sizes is $\sqrt[4]{2} \cdot f^{n}$

where n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and where the following equation applies to the factor f:

$$53 = 1{,}2\left(\sqrt[4]{2}\right)^{12} \cdot f^{(0+1+2+3+.....+11)}$$

$$f = \sqrt[66]{\frac{53}{1{,}2\left(\sqrt[4]{2}\right)^{12}}} = 1{,}026$$

This produces a series of ratios starting at 1,189 and ending at 1,581.

Table 3 — Calculation of the f^n factors (photosedimentation)

Grit designation	Median grain size µm	Formula
F230	53	Starting point
F240	44,5	$f^0 = 1 = \frac{53}{44,5} \cdot \frac{1}{\sqrt[4]{2}}$
F280	36,5	$f^1 = \frac{44,5}{36,5} \cdot \frac{1}{\sqrt[4]{2}}$
F320	29,5	$f^2 = \frac{36,5}{29,5} \cdot \frac{1}{\sqrt[4]{2}}$
F360	22,8	$f^3 = \frac{29,2}{22,8} \cdot \frac{1}{\sqrt[4]{2}}$
F400	17,3	$f^4 = \frac{22,8}{17,3} \cdot \frac{1}{\sqrt[4]{2}}$
F500	12,8	$f^5 = \frac{17,3}{12,8} \cdot \frac{1}{\sqrt[4]{2}}$
F600	9,3	$f^6 = \frac{12,8}{9,3} \cdot \frac{1}{\sqrt[4]{2}}$
F800	6,5	$f^7 = \frac{9,3}{6,5} \cdot \frac{1}{\sqrt[4]{2}}$
F1000	4,5	$f^8 = \frac{6,5}{4,5} \cdot \frac{1}{\sqrt[4]{2}}$
F1200	3	$f^9 = \frac{4,5}{3} \cdot \frac{1}{\sqrt[4]{2}}$
F1500	2	$f^{10} = \frac{3}{2} \cdot \frac{1}{\sqrt[4]{2}}$
F2000	1,2	$f^{11} = \frac{2}{1,2} \cdot \frac{1}{\sqrt[4]{2}}$

5 Testing microgrits F230 to F2000

5.1 General

Microgrits F230 to F2000 are tested by means of sedimentation.

The criteria for determining the grain size distribution are

a) the theoretical grain size at the 3 % point of the grain size distribution curve (d_{s3} value),

b) the theoretical grain size at the 50 % point of the grain size distribution curve (d_{s50} value), and

c) the theoretical grain size at the 80 %, 94/95 % point of the grain size distribution curve (d_{s80}, $d_{s94/95}$ values).

5.2 Permissible deviations

When retesting the measured results, allowance shall be made for the variations due to the measuring technique (sampling, sample preparation, different operators and instruments). These permissible deviations, given in Tables 4 and 5, have been determined on the basis of the standard deviation resulting from a cooperative test carried out by the members of ISO TC 29/SC 5. The tolerances given in Tables 1 or 2 are to be increased by these values.

Table 4 — Permissible deviations resulting from variations due to measuring technique — Method based on mastergrits

(Determination, for example, by sedimentation or electrical resistance method)

Dimensions in micrometres

Grit designation	Permissible deviations for values			
	d_{s3}	d_{s50}	d_{s80}	d_{s94}
F230	+ 3,5	± 2,5	—	− 1,5
F240				
F280	+ 2,5	± 1,5	—	− 0,8
F320				
F360				
F400				
F500	+ 2	± 1	—	− 0,5
F600				
F800				
F1000	+ 1,5	± 0,5	—	− 0,4
F1200			− 0,4	—
F1500	+ 1,0	± 0,4	− 0,3	—
F2000	+ 1,0	± 0,3	− 0,2	—

Table 5 — Permissible deviations resulting from the variations due to the measuring technique — US sedimentation tube method

Dimensions in micrometres

Grit designation	Permissible deviations for the values			
	d_{s3}	d_{s50}	d_{s80}	d_{s95}
F230	+ 1,5	± 1,5	—	− 1,5
F240				
F280	+ 1,5	± 1	—	− 1,5
F320				
F360				
F400				
F500	+ 1,5	± 0,8	—	− 1,5
F600				
F800				
F1000	+ 1,5	± 0,5	—	− 1,5
F1200			− 1,5	—

5.3 Designation of test method

The designation of the method for testing microgrits F230 to F2000 shall include an indication of the measuring instrument used:

— test-MICRO F — Sedigraph series[1];

— test-MICRO F — US sedimentation tube[1];

— test-MICRO F — Coulter counter[1].

1) Sedigraph, US sedimentation tube and Coulter counter are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 8486 and does not constitute an endorsement by ISO of these products.

6 Test methods

6.1 Test method based on Micro-F-Mastergrits

Each of the *Micro-F-Mastergrits* [2)] (hereafter referred to as "mastergrit") used in testing is accompanied by a certificate of the *Staatliche Materialprüfungsanstalt Darmstadt* (MPA) stating the value at the 50 % point determined by means of a cooperative test carried out by the members of ISO TC 29/SC 5. The values measured shall be corrected on the basis of the mastergrit values.

The determination of grain sizes by use with other principles of measurement than sedimentation may give deviating results.

6.1.1 Preparation of the sample

It is recommended that the sample be dispersed by means of ultrasonics.

6.1.2 Test procedure

The test shall be carried out in accordance with the instructions for the measuring instrument used.

6.1.3 Evaluation

6.1.3.1 Determination of grain size distribution

The principle upon which this part of ISO 8486 is based is the comparison of the median d_{s50} (50 % by volume weight) point given by the mastergrit with that determined by the testing laboratory on its own instruments.

The difference between these two values is also to be added algebraically to the 3 %, 50 %, 80 % or 94/95 % values of the sample.

The following procedure applies:

a) determine the d_{s50} value of the mastergrit, and calculate the difference between this value and the corresponding value shown on the MPA Darmstadt certificate;

b) measure the d_{s3}, d_{s50}, d_{s80} or $d_{s94/95}$ values of the sample and add, algebraically, the mastergrit difference as determined above;

c) compare the corrected measured results with the values in Table 1.

EXAMPLE SiC F240, for the d_{s50} value:

— Mastergrit (MG):

MG - d_{s50} value according to MPA certificate	44,9 µm
MG - d_{s50} value measure	42,3 µm
Difference	+ 2,6 µm

— Sample:

Value measured	42,8 µm
To be added	+ 2,6 µm
Corrected value of the sample	45,4 µm

From Table 1, this value is within the tolerances of the d_{s50} value for grit F240.

2) *Micro-F-Mastergrits*, of fused aluminium oxide and silicon carbide, can be obtained from the *Staatliche Materialprüfungsanstalt Darmstadt*, Grafenstraße 2, 64283 Darmstadt, Germany. This information is given for the convenience of users of this part of ISO 8486 and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

6.1.3.2 Evaluation of corrected test results

A sample complies with this part of ISO 8486 if the corrected values for d_{s3}, d_{s50}, d_{s80} or $d_{s94/95}$ are within the permissible limits given in Table 1 or 2.

When retesting a material, allowance shall be made for the variation due to the measuring techniques.

The limit deviations given in Tables 1 or 2 are to be amended by the values given in Tables 4 or 5.

6.1.4 Measuring apparatus

6.1.4.1 X-ray gravitational technique

6.1.4.1.1 General

The X-ray gravitational technique is a method for the determination of the particle size distribution of a powder dispersed in a liquid using gravity sedimentation. The measurement of the concentration of solids setting in a liquid suspension is achieved by monitoring the incremental signal absorption from a beam of X-rays. The method of determining the particle size distribution is applicable to powders which can be dispersed in liquids or powders which are present in slurry form. The typical particle size range for analysis is from about 0,1 µm to about 300 µm. The method is typically used for materials containing particles of approximately the same chemical composition which produce adequate X-ray opacity.

6.1.4.1.2 Underlying theory

The method is based on two physical phenomena: low energy X-ray absorption and gravitational sedimentation, where Stokes' law describes the gravitational sedimentation of a particle as a function of particle diameter. These two phenomena allow both the particle diameter and the corresponding mass of all particles of that size to be determined.

a) Particle diameter determination

Particle size is determined from velocity measurements by applying Stokes' law under the known conditions of liquid density and viscosity, and particle density. Settling velocity is determined at each relative mass measurement from knowledge of the distance the X-ray beam from the top of the sample cell and the time at which the mass measurement was taken. From the velocity equals distance divided by time relationship, it can be determined the maximum velocity of all particles remaining above the measurement zone, these velocities being associated with the finer particles, see Figure 1.

b) Mass determination

A narrow, horizontally collimated beam of X-rays is used to measure directly the relative mass concentration of particles in the liquid medium. This is done by first measuring the intensity of a reference X-ray beam that is projected through the clear liquid medium prior to the introduction of the sample. A homogeneously dispersed mixture of solid sample and liquid is next circulated through the cell. The solid particles absorb some of the X-ray energy, which again is measured, this time to establish a value for full scale attenuation. Agitation of the mixture is ceased and the dispersion is allowed to settle while X-ray intensity is monitored.