
**Coated abrasives — Determination
and designation of grain size
distribution —**

**Part 3:
Microgrit sizes P240 to P5000**

*Abrasifs appliqués — Détermination et désignation de la distribution
granulométrique —*

Partie 3: Micrograins P240 à P5000



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces ISO 6344-3:2013 and ISO 6344-1:1998, which have been technically revised.

The main changes compared to ISO 6344-3:2013 and ISO 6344-1:1998 are as follows:

- the title and the scope have been changed and updated due to the extension of grit designations up to P5000;
- relevant content of ISO 6344-1:1998 has been updated and transferred to this document and ISO 6344-2;
- references to ISO 6344-1:1998 have been deleted;
- normative references have been updated;
- [Clause 3](#) "Terms and definitions" has been updated;
- former [Clause 4](#) "Testing of microgrit sizes P240 to P1200" has been revised in its content and divided into two clauses: [Clause 4](#) "Grain size distribution of microgrit sizes P240 to P1200" and [Clause 5](#) "Test method of microgrit sizes P240 to P1200";
- the checking mineral 280 has been deleted;
- former [Tables 3](#) and [4](#) for the theoretical equivalent grain diameters have been moved to a new [Annex A](#) "Theoretical equivalent grain diameters, d , for grits of fused aluminium oxide and for grits of silicon carbide";
- former [Clause 5](#) has been revised in its content and divided into two clauses: [Clause 6](#) "Grain size distribution of microgrit sizes P1500 to P5000" and [Clause 7](#) "Test method of microgrit sizes P1500 to P5000";

- the grit designations P3000, P4000 and P5000 have been added;
- [Clause 8](#) "Test report" has been added;
- [Clause 10](#) (former Clause 7) "Marking" has been revised;
- [Annexes B](#) and [C](#) (former [Annexes A](#) and [B](#)) have been revised;
- Bibliography has been updated.

A list of all parts in the ISO 6344 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Coated abrasives — Determination and designation of grain size distribution —

Part 3: Microgrit sizes P240 to P5000

1 Scope

This document specifies a method for determining and testing the grain size distribution of electro-fused aluminium oxide and silicon carbide microgrit sizes P240 to P5000 for coated abrasive products.

It is applicable to grits used in the manufacture of coated abrasive products and to grits extracted from coated abrasive products for test purposes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 9138, *Abrasive grains — Sampling and splitting*

ISO 13317-3, *Determination of particle size distribution by gravitational liquid sedimentation methods — Part 3: X-ray gravitational technique*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

microgrit

abrasive grit having a median equivalent diameter of 58,5 μm to 2,7 μm whose *grain size distribution* (3.2) is determined by sedimentation

3.2

grain size distribution

particle size distribution

PSD

percentage of grains of different sizes composing the macrogrit or *microgrit* (3.1)

4 Grain size distribution of microgrit sizes P240 to P1200

The testing of microgrit sizes P240 to P1200 by sedimentation shall be carried out using the US sedimentometer (see 5.2.1). The principle of measurement is to determine the volume as a function of time of particles settled in the collecting tube. The equivalent grain size diameters are calculated using Stokes' law.

The grain size distribution of microgrit sizes P240 to P1200 is determined using the following criteria:

- the maximum grain diameter (theoretical equivalent grain diameter) of the first sedimented grain (d_{s0} value) shall not exceed the maximum permissible d_{s0} value;
- the grain diameter (theoretical equivalent grain diameter) shall not exceed the maximum permissible d_{s3} value at the 3 % point of the grain size distribution curve;
- the median grain diameter (theoretical equivalent grain diameter) shall be within the specified tolerances of the d_{s50} value at the 50 % point of the grain size distribution curve;
- the grain diameter (theoretical equivalent grain diameter) shall exceed the minimum permissible d_{s95} value at the 95 % point of the grain size distribution curve.

All four criteria (d_{s0} , d_{s3} , d_{s50} , d_{s95}) shall be fulfilled simultaneously.

The grain size distribution limit values (d_s values) for P240 to P1200 based on testing with US sedimentometer shall be according to [Table 1](#).

Table 1 — Limit d_s values for P240 to P1200

Grit designation	d_{s0} value	d_{s3} value	Median grain size		d_{s95} value
	max. μm	max. μm	d_{s50} value μm		min. μm
P240	110	81,7	58,5	$\pm 2,0$	44,5
P280	101	74,0	52,2	$\pm 2,0$	39,2
P320	94	66,8	46,2	$\pm 1,5$	34,2
P360	87	60,3	40,5	$\pm 1,5$	29,6
P400	81	53,9	35,0	$\pm 1,5$	25,2
P500	77	48,3	30,2	$\pm 1,5$	21,5
P600	72	43,0	25,8	$\pm 1,0$	18,0
P800	67	38,1	21,8	$\pm 1,0$	15,1
P1000	63	33,7	18,3	$\pm 1,0$	12,4
P1200	58	29,7	15,3	$\pm 1,0$	10,2

NOTE The d_s values are results of cooperative tests.

5 Test method of microgrit sizes P240 to P1200

5.1 Materials

5.1.1 Sedimentation medium

As the sedimentation medium use methyl alcohol of 95 % to 99 % purity.

Adjust the sedimentation medium using the checking minerals specified in [5.1.3](#).

5.1.2 Dispersing agent

In order to avoid grain agglomeration, a dispersing agent, such as EDTA (tetrasodium salt of ethylenediamine tetra-acetic acid), shall be added to the methyl alcohol, i.e. 4 ml of a 1 % aqueous EDTA-solution per litre of methyl alcohol.

5.1.3 Checking minerals

The adjustment of the whole measuring procedure is controlled by means of the checking mineral 320¹⁾. Each supply of the checking mineral is accompanied by a cumulative volume grain size distribution curve (see [Figure 1](#)). The 10 %, 20 %, 30 %, 40 % and 50 % points shall not deviate by more than ± 2 % from the sizes indicated in [Table 2](#).

NOTE The grain size distributions of the checking mineral 320 do not correspond to the grain size distribution of the microgrit P320 of this document.

Table 2 — Grain diameter of the checking mineral 320

Volume fraction of the settled checking mineral	Grain diameter
%	d μm
0	75,1
3	58,7
10	$49,8 \pm 1,00$
20	$44,2 \pm 0,88$
30	$40,5 \pm 0,81$
40	$37,5 \pm 0,75$
50	$34,9 \pm 0,70$
60	32,5
70	30,1
80	27,5
90	24,4
100	16,5

1) Checking mineral 320 (edition 2009) can be obtained by: State Materials Testing Institute Darmstadt (Staatliche Materialprüfungsanstalt Darmstadt, MPA), Grafenstraße 2, D-64283 Darmstadt, Germany. This information is given for the convenience of users of this document 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.

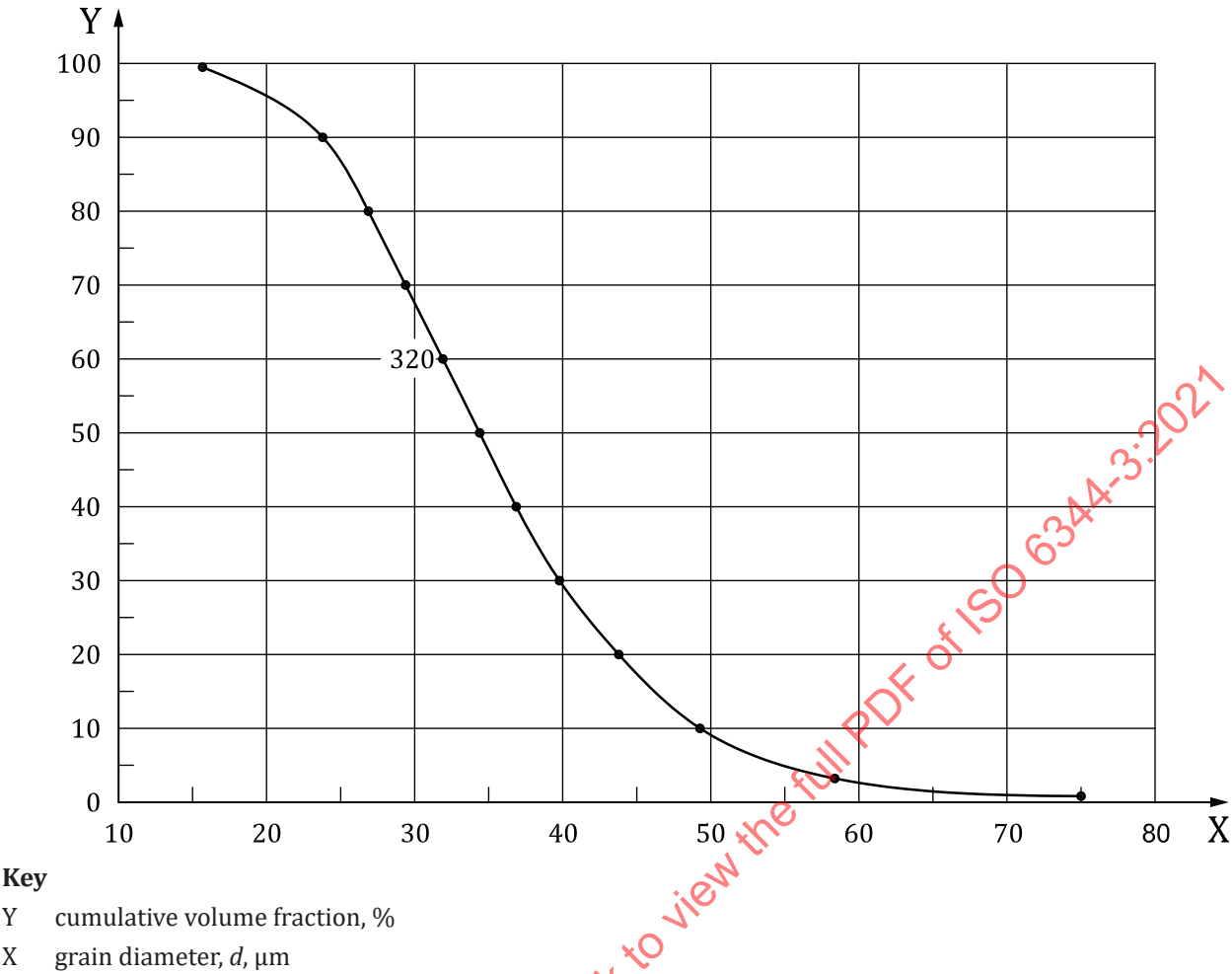


Figure 1 — Cumulative volume grain size distribution curve of the checking mineral 320

5.2 Apparatus

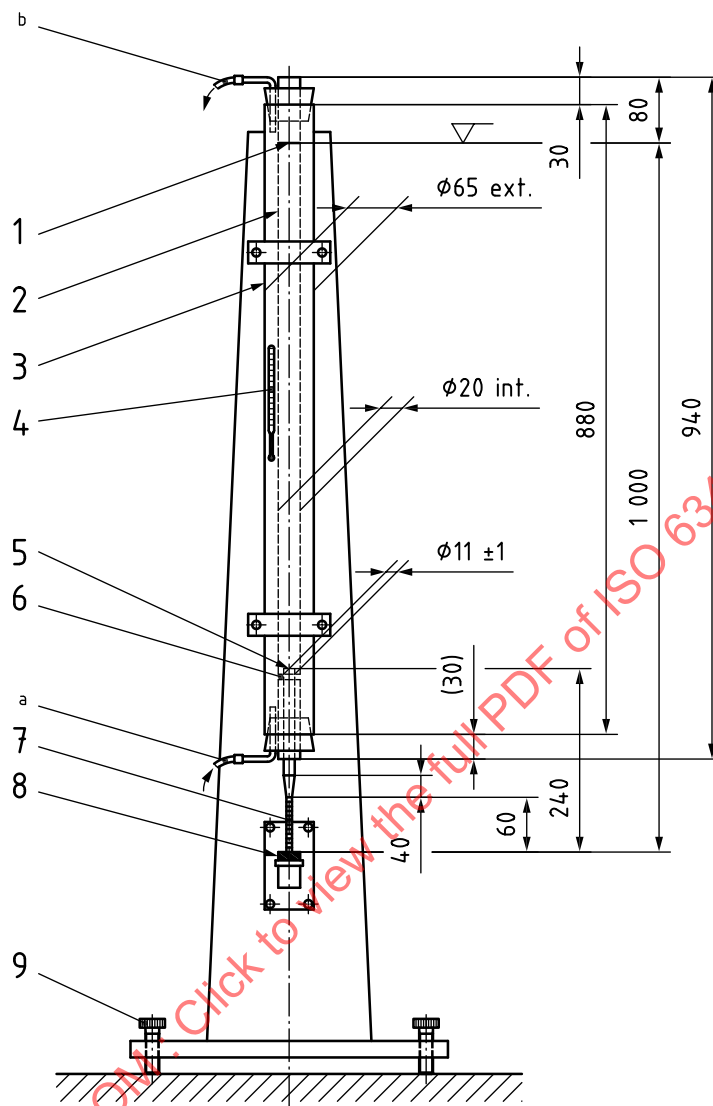
5.2.1 US sedimentometer, in accordance with [Figure 2](#). It consists of a vertical sedimentation tube of 940 mm in length and of a 20 mm inside diameter. It is surrounded by a water jacket in which the water temperature is maintained at a constant level. A graduated collecting tube is fixed at the bottom of the sedimentation tube. The whole assembly is mounted on a frame, the base plate of which is fitted with level adjusting screws for keeping the tube vertical (see [Figure 2](#)). The design and dimensions of the collecting tube shall be made in accordance with [Figure 3](#).

5.2.2 Horizontal beam light source, which can be used to improve the accuracy of sedimentation volume readings.

5.2.3 Magnifying glass, which can be used to improve the accuracy of sedimentation volume readings.

5.2.4 Time printer, which can be used to make the recording of the sedimentation times easier.

Dimensions in millimetres



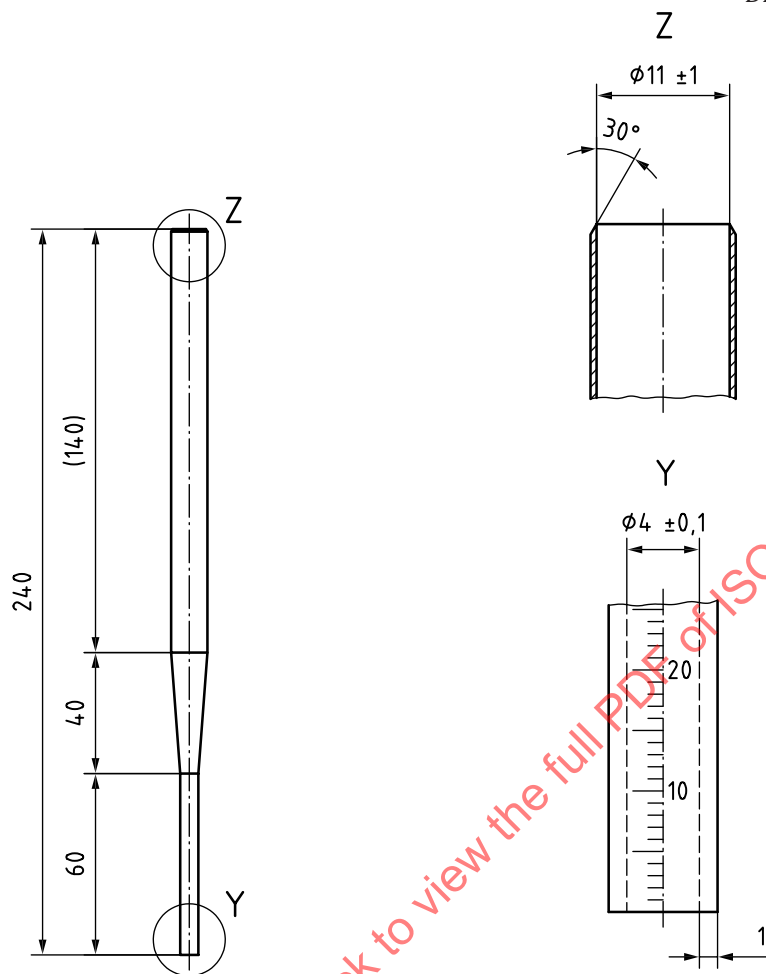
Key

- 1 methyl alcohol level (initial)
- 2 sedimentation tube
- 3 water jacket
- 4 thermometer
- 5 collecting tube (see [Figure 3](#))
- 6 rubber centring spacer

- 7 scale for height of sedimentation
- 8 rubber gasket
- 9 vertical adjusting screws
- a Water inlet.
- b Water outlet.

Figure 2 — US sedimentometer

Dimensions in millimetres



The following parameters are recommended:

- Dial graduation and figures should be in white.
- 50 division marks at equal intervals (graduation about 1 mm).
- Length of division mark: 3 mm
- Length of every fifth division mark: 4 mm
- Thickness of division mark: 0,25 mm

Figure 3 — Collecting tube

5.3 Preparation

5.3.1 Preparation of the apparatus

5.3.1.1 Setting up the test device

When setting up the US sedimentometer, check that the collecting tube is positioned centrally in the sedimentation tube. It is held in the vertical position by a rubber spacer located about 30 mm from the top of the collecting tube. Check the position using a plumb line suspended from the top of the sedimentation tube and the collecting tube. The plumb line shall pass centrally through both the

sedimentation tube and the collecting tube. The device is adjusted by means of the adjusting screws on the base plate.

After adjustment, fill the water jacket and connect it to a thermostat.

5.3.1.2 Test temperature

The testing of the grain size distribution shall be carried out under constant temperature with a permissible deviation of $\pm 0,1$ °C.

It is convenient to use a test temperature of 25 °C. The grain diameters indicated in [Tables A.1](#) and [A.2](#) for the respective times of sedimentation apply to this temperature only.

For the determination of the grain diameters for other test temperatures, see [5.5.1](#).

5.3.1.3 Adjustment of the sedimentation medium

The methyl alcohol used for the test shall be adjusted by means of the checking mineral 320.

The grain sizes corresponding to 10 %, 20 %, 30 %, 40 % and 50 % points shall not deviate by more than $\pm 0,5$ μm from the values specified on the curves supplied with the checking mineral. The average of the algebraic sum of the deviations shall not exceed $\pm 0,3$ μm .

If an agreement with the accompanying curves is not reached within the permissible tolerances, then the density and viscosity of the sedimentation medium shall be changed such that an agreement is obtained.

5.3.2 Preparation of the test portion

Sampling and splitting of abrasive grains shall be in accordance with ISO 9138.

Prior to the test, the test portion shall be heated to a temperature of $600\text{ °C} \pm 20\text{ °C}$ for at least 10 min.

5.4 Procedure

5.4.1 Filling of sedimentation tube

Fill the sedimentation tube with the previously adjusted sedimentation liquid to a height of $1\,000\text{ mm} \pm 2\text{ mm}$ (measured from the bottom of the collecting tube). Allow it to stand until equilibrium is reached between the water jacket connected to the thermostat and the sedimentation tube temperatures.

5.4.2 Dispersion of the test portion

After sedimentation, the collecting tube shall be filled up to a height of 20 to 25 divisions with the test portion. For silicon carbide, the amount of test portion should be about 1,6 g, and for fused aluminium oxide it should be about 2,2 g.

Prepare a slurry of 15 ml of sedimentation medium containing the specified quantity of dispersing agent and the test portion. Shake the slurry to achieve complete dispersion. Allow the grit to stand in the sedimentation medium for at least 30 min and then again shake the test tube vigorously several times during this period. The temperature of the medium shall be the same as the temperature of the medium in the sedimentation tube.

Ultrasonic treatment is recommended to obtain a suspension free of agglomerates.

5.4.3 Transfer to sedimentation tube

Place a suitable funnel in the sedimentation tube. Shake the test tube containing the test portion and the sedimentation liquid vigorously for at least 30 s. Then, pour its contents onto the sedimentation liquid, down the slope of the funnel.

Subsequently, quickly remove the funnel from the sedimentation tube in order to prevent any residue from dropping into the tube as this would distort the results.

5.4.4 Start of measurement

Measurement shall begin at the time of transfer of the test portion.

For the theoretical equivalent grain diameters, d , for grits of fused aluminium oxide and for grits of silicon carbide see [Annex A](#).

5.4.5 Determination of the maximum grain size

For the determination of the maximum grain size, the time period is measured between the transfer of test portion to the tube (start of measurement) and the moment when the first grain reaches the bottom of the collecting tube.

The grain size of fused aluminium oxide can be determined according to [Table A.1](#) and the grain size for silicon carbide according to [Table A.2](#).

The diameter of the first sedimented grain is the d_{s0} value (first grain).

If the permissible d_{s0} value is exceeded, the test shall be repeated with one or more new test portions. Check for agglomeration.

5.4.6 Recording measurement values

The initial point of the grain size distribution curve is the time when the first continuous flow of particles reaches the bottom of the collecting tube. Check for agglomeration.

The time shall be recorded when the volume between the measurement lines is filled. This shall be detected when the surfaces of the grains are reaching the measurement line.

To avoid the error in reading, the view on the tube needs to be in line with the measurement lines.

The end point of measurement is that time when all the particles have settled, i.e. when the height of sedimentation is no longer changing.

During sedimentation, the rubber gasket at the bottom of the collecting tube shall be tapped gently but continuously. This may be carried out by means of a tapper. It shall, however, not be tapped on the pressing lever supporting the tube or on the tube itself.

If agglomerations of abrasive grains can be observed during the sedimentation, this is a sign of insufficient pretreatment of the test portion. In such cases, the measurement procedure shall be repeated with proper sample preparation as specified in [5.4.2](#).

5.5 Evaluation

5.5.1 General

For representation of the grain size distribution curve, two parameters shall be determined: the grain size diameter according to [5.5.2](#) and the respective volume fraction according to [5.5.3](#).

5.5.2 Determination of the grain diameter, d

The determination of the grain size distribution according to this test method is based on Stokes' law. Since all conditions, except the time of sedimentation, and the grain size are constant for a given microgrit, the Stokes' formula can be simplified following [Formula \(1\)](#):

$$d = \frac{K}{\sqrt{t}} \quad (1)$$

where

d is the equivalent grain diameter, in micrometres;

K is the constant whose value is dependent upon temperature, material to be tested and sedimentation medium;

t is the time of sedimentation, in minutes.

When the test temperature is 25 °C, the K values for methyl alcohol are 79,7 for fused aluminium oxide and 91,1 for silicon carbide.

These values represent a basis for the determination of the equivalent grain diameters in [Table A.1](#) and [Table A.2](#). For other test temperatures, the grain diameters shall also be calculated according to Stokes' law.

The K values for the temperatures between 18 °C and 30 °C are given in [Table 3](#).

Table 3 — K values

Test temperature θ °C	K values	
	Fused aluminium oxide	Silicon carbide
18	84,3	96,3
19	83,7	95,5
20	83,0	94,8
21	82,3	94,1
22	81,7	93,3
23	81,0	92,6
24	80,4	91,8
25	79,7	91,1
26	79,1	90,3
27	78,4	89,6
28	77,8	88,9
29	77,1	88,1
30	76,5	87,4

The formulae for the determination of the K values are as follows:

— for fused aluminium oxide: $K = 96,16 - 0,657 \theta$

— for silicon carbide: $K = 109,6 - 0,741 \theta$

where θ is the temperature of medium in the sedimentation tube, in °C.

NOTE Concerning the case of application described in this subclause, Stokes' Law states that grains reaching the bottom of the collecting tube (or the surface of the grains already settled at the bottom of the collecting tube) after a time, t , in minutes, has an equivalent diameter, d , in micrometres.

5.5.3 Determination of the volume fraction

A template given in [Table B.1](#) may be used for the recording and interpretation of the data, showing:

- column 1: height of sedimentation, h , in division lines as marked on the collecting tube;
- column 2: time of sedimentation t ;
- column 3: volume fraction of the settled test portion determined according to [Table 4](#);
- column 4: grain diameter, d , for fused aluminium oxide determined according to [Table A.1](#) and for silicon carbide determined according to [Table A.2](#).

Volume fractions of settled test portion are calculated as function of height of sedimentation, h , related to total height of sedimentation, h_{tot} , of test portion in [Table 4](#).

Table 4 — Volume fractions as function of height of sedimentation

Height of sedimentation h in division marks	Total height of sedimentation, h_{tot} , of test portion in division marks										
	20,0	20,5	21,0	21,5	22,0	22,5	23,0	23,5	24,0	24,5	25,0
	Volume fraction of settled test portion %										
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	8,3	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	16,7	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	63,3	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	100,0	97,6	95,2	93,0	90,9	88,9	87,0	85,1	83,3	81,6	80,0
21	—	100,0	100,0	97,7	95,5	93,3	91,3	89,4	87,5	85,7	84,0
22	—	—	—	100,0	100,0	97,8	95,7	93,6	91,7	89,8	88,0
23	—	—	—	—	—	100,0	100,0	97,9	95,8	93,9	92,0

Table 4 (continued)

Height of sedimentation h in division marks	Total height of sedimentation, h_{tot} , of test portion in division marks										
	20,0	20,5	21,0	21,5	22,0	22,5	23,0	23,5	24,0	24,5	25,0
	Volume fraction of settled test portion %										
24	—	—	—	—	—	—	—	100,0	100,0	98,0	96,0
25	—	—	—	—	—	—	—	—	—	100,0	100,0

5.5.4 Representation of the grain size distribution curve

In the grain size distribution curve, the volume fractions of the sedimented test portion are displayed on the ordinate against the grain equivalent diameters, d , on the abscissa (see [Figure 4](#)).

The d_{s3} , d_{s50} and d_{s95} values shall be read from the grain size distribution curve.

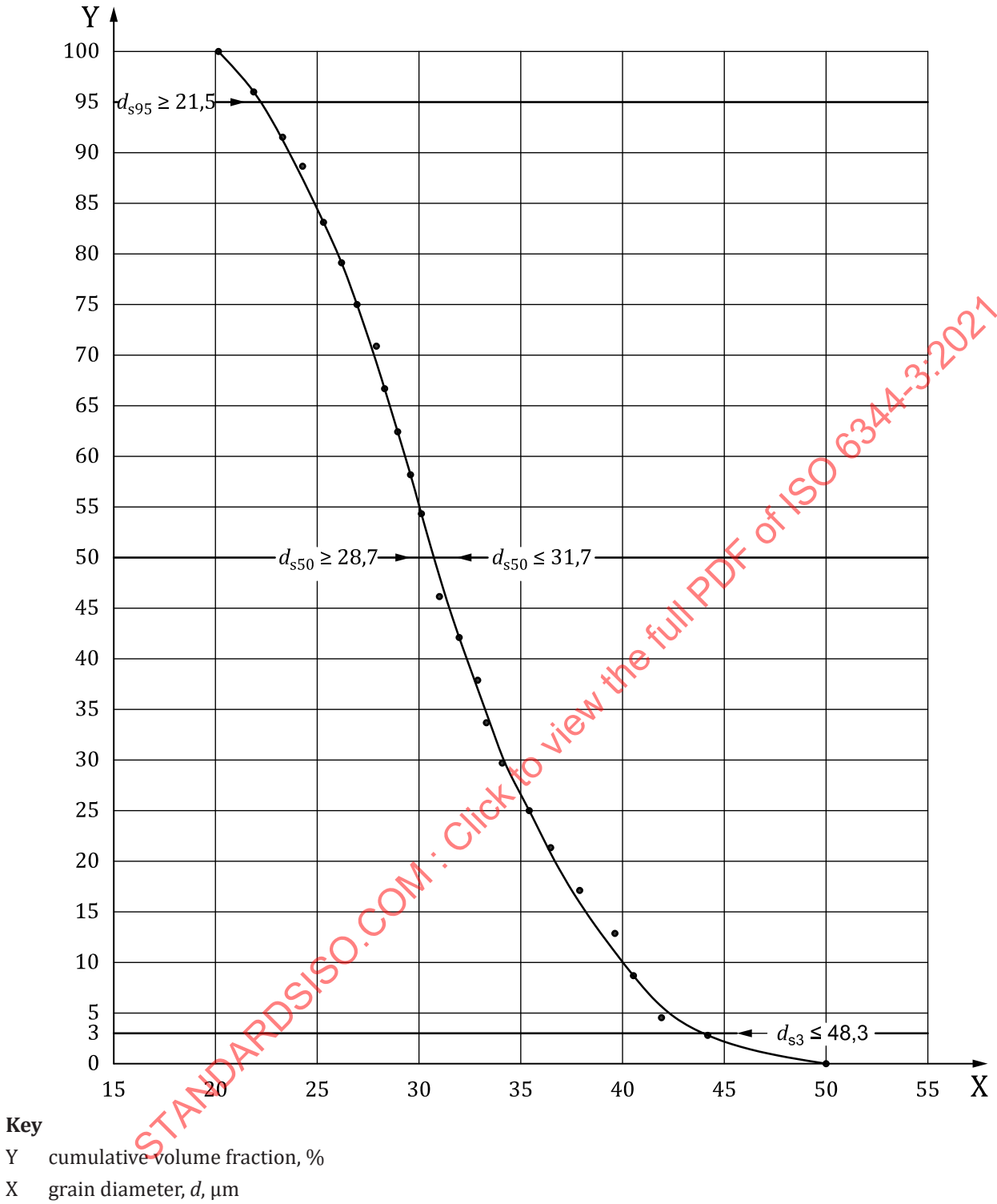


Figure 4 — Example of a grain size distribution curve according to the values in Table C.1

5.5.5 Evaluation of the grain size distribution

In the grain size distribution curve, the d_{s0} , d_{s3} , d_{s50} and d_{s95} values of the test portion are read and compared with the permissible limit values according to Table 1.

The test portion is in accordance with this document when the d_{s0} , d_{s3} , d_{s50} and d_{s95} values are within the permissible limit values according to Table 1.

5.5.6 Example of measuring a test portion of fused aluminium oxide

A grit made of fused aluminium oxide is tested in the sedimentation medium at a temperature of 25 °C.

The time is measured and recorded when the first continuous flow of particles reaches the bottom of the collecting tube.

After this, the times are recorded when the sedimentation heights, h , have reached one division mark each. At the end of the measurement, the total sedimentation height, h_{tot} , reaches 24 division marks. The established times are entered in column 2 of [Table B.1](#).

The volume fractions of the test portion can only be determined after the termination of the measurement, when the total height of sedimentation, h_{tot} , is established. They are determined on the basis of [Table 4](#) and entered in [Table B.1](#).

For the times of sedimentation, t , given in column 2, the grain diameter, d , shall be determined from [Table A.1](#) and entered in column 4 of [Table B.1](#).

For generating the grain size distribution curve, the volume fractions of the test portion (column 3 of [Table B.1](#)) are entered against the corresponding grain size (column 4 of [Table B.1](#)), see [Figure 4](#).

The established d_{s0} , d_{s3} , d_{s50} and d_{s95} values shall be compared with the limit values according to [Table 1](#).

NOTE An example of the template according to [Annex B](#) is given in [Annex C](#).

5.5.7 Permissible deviations

On second checking of the measured results, allowance shall be made for the variations due to the measuring technique. The limit values for microgrit sizes given in [Table 1](#) shall be extended by the values given in [Table 5](#).

Table 5 — Permissible deviations for P240 to P1200 resulting from the variations due to the measuring technique

Grit designation	Permissible deviation ^a		
	d_{s3} value	d_{s50} value	d_{s95} value
P240	+1,5	±1,5	-1,5
P280			
P320			
P360	+1,5	±1,0	-1,5
P400			
P500			
P600	+1,5	±0,8	-1,5
P800			
P1000			
P1200			

^a Determined by results of cooperative tests.

6 Grain size distribution of microgrit sizes P1500 to P5000

The grain size distribution of microgrit sizes P1500 to P5000 is determined using the following criteria:

- the grain diameter (theoretical equivalent grain diameter) shall not exceed the maximum permissible $d_{s1,6}$ value at the 1,6 % point of the grain size distribution curve;

- b) the grain diameter (theoretical equivalent grain diameter) shall not exceed the maximum permissible d_{s3} value at the 3 % point of the grain size distribution curve;
- c) the median grain diameter (theoretical equivalent grain diameter) shall be within the specified tolerances of the d_{s50} value at the 50 % point of the grain size distribution curve;
- d) the grain diameter (theoretical equivalent grain diameter) shall exceed the minimum permissible d_{s95} value at the 95 % point of the grain size distribution curve.

All four criteria ($d_{s1,6}$, d_{s3} , d_{s50} , d_{s95}) shall be fulfilled simultaneously.

The grain size distribution limit values (d_s values) for P1500 to P5000 based on testing with sedimentation shall be in accordance with [Table 6](#).

Table 6 — Limit d_s values for P1500 to P5000

Grit designation	$d_{s1,6}$ value max. μm	d_{s3} value max. μm	Median grain size d_{s50} value μm	d_{s95} value min. μm
P1500	22,0	18,5	$8,6 \pm 0,8$	4,1
P2000	18,5	15,0	$6,5 \pm 0,6$	3,0
P2500	15,0	12,5	$5,4 \pm 0,4$	1,7
P3000	12,5	10,0	$4,5 \pm 0,4$	1,4
P4000	10,0	8,5	$3,6 \pm 0,4$	1,0
P5000	8,5	6,7	$2,7 \pm 0,4$	0,7

NOTE The d_s values are results of cooperative tests.

7 Test method of microgrit sizes P1500 to P5000

7.1 Materials

7.1.1 Micro-P-Mastergrits

Micro-P-Mastergrits²⁾ are well-defined reference grits, being associated with test reports of the grain size distribution including $d_{s1,6}$, d_{s3} , d_{s50} and d_{s95} values. The test reports shall be determined in cooperative interlaboratory tests. These cooperative interlaboratory tests shall be supervised by an independent institution like for example the MPA²⁾. This institution is responsible for defining the values in the test reports.

The method for measuring the values of grain size distribution shall be done by sedimentation using X-ray gravitational technique according to [7.2](#).

7.1.2 Dispersing medium

The dispersing medium consists of a solution of the sedimentation medium and the dispersing agent, according to [Table 7](#).

2) Micro-P-Mastergrits of fused aluminium oxide and silicon carbide can be obtained by: State Materials Testing Institute Darmstadt (Staatliche Materialprüfungsanstalt Darmstadt, MPA), Grafenstraße 2, D-64283 Darmstadt, Germany. This information is given for the convenience of users of this document 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.

Table 7 — Sedimentation medium and dispersing agent for testing microgrit sizes of aluminium oxide and silicon carbide

Microgrit sizes	Sedimentation medium at 20 °C	Dispersing agent Sodium hexametaphosphate (NaPO ₃) _n g/l	
		Aluminium oxide	Silicon carbide
P1500	Deionized water conductivity ≤5 µS	0,45	0,20
P2000			
P2500			
P3000			
P4000			
P5000			

7.2 Apparatus

The test method for microgrit sizes P1500 to P5000 shall be done by sedimentation, using the X-ray gravitational technique in accordance with ISO 13317-3 (e.g. SediGraph III Plus®³⁾). It is a method for the determination of the grain 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 grain size distribution is applicable to powders which can be dispersed in liquids or powders which are present in slurry form. Typical grain 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.

The determination of grain sizes with other measuring instruments may give deviating results. Other instruments are for example the electrical resistance method or instruments using other principles of measurement. Other instruments shall be calibrated with Mastergrits following the description in this document. In case of dispute according to grain size distribution, an arbitration analysis shall be carried out by sedimentation using X-ray gravitational technique according to the procedures described in this document.

7.3 Preparation

7.3.1 Preparation of the test portion

Sampling and splitting of abrasive grains shall be carried out in accordance with ISO 9138.

The test portion shall be dispersed at 20 °C in the dispersing medium according to 7.1.2. It is recommended to treat the suspension by ultrasonic finger for 5 min.

7.3.2 Calibration of the Apparatus

The test procedure is based on the calibration with Micro-P-Mastergrits P1500, P2000, P2500, P3000, P4000 and P5000 (made of fused aluminium oxide or silicon carbide).

Calibration of the apparatus shall be carried out in suitable intervals.

3) SediGraph III Plus® is a tradename of Micromeritics. This information is given for the convenience of users of this document 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.

For calibration the $d_{s1,6}$, d_{s3} , d_{s50} and d_{s95} values of the Micro-P-Mastergrit shall be determined. The values for correction (see [Table 8](#), row 3) are the difference between the value of the test report and the measured value.

7.4 Procedure for the determination of the grain size distribution

Determine the grain size distribution ($d_{s1,6}$, d_{s3} , d_{s50} and d_{s95} values) of the test portion according to the instruction of the apparatus (see [Table 8](#), row 4).

The final corrected results shall be calculated by algebraic addition of the correction values and the measured values of the test portion.

Table 8 — Example: SiC P2000

Row	Grit designation	Grain size distribution μm			
		$d_{s1,6}$ value	d_{s3} value	d_{s50} value	d_{s95} value
1	Mastergrit, values given in the test report	12,8	11,6	6,4	3,7
2	Mastergrit, values measured	13,2	11,8	6,5	3,8
3	Corrected correction value (difference between row 1 and 2)	-0,4	-0,2	-0,1	-0,1
4	Test portion value as measured	14,3	12,0	6,7	3,6
5	Final corrected result of test portion (sum of row 3 and 4)	13,9	11,8	6,6	3,5

7.5 Evaluation

7.5.1 Evaluation of the grain size distribution

The result of the $d_{s1,6}$, d_{s3} , d_{s50} and d_{s95} values of the test portion shall be compared with the limit values according to [Table 6](#).

The test portion is in accordance with this document when the $d_{s1,6}$, d_{s3} , d_{s50} and d_{s95} values are within the permissible limit values according to [Table 6](#).

7.5.2 Permissible deviations

Cooperative interlaboratory tests have shown a certain variation of results ([Table 9](#)).

On second checking of the measured results, allowance shall be made for the variations due to the measuring technique.

The limit values for microgrit sizes given in [Table 6](#) shall be extended by the values given in [Table 9](#).

Table 9 — Permissible deviations for P1500 to P5000 resulting from the variations due to the measuring technique

Grit designation	Permissible deviations ^a			
	μm			
	$d_{s1,6}$ value	d_{s3} value	d_{s50} value	d_{s95} value
P1500	+3,0	+1,5	$\pm 1,0$	-0,4
P2000	+3,0	+1,5	$\pm 0,8$	-0,4
P2500	+2,0	+1,0	$\pm 0,6$	-0,3
P3000	+2,0	+1,0	$\pm 0,3$	-0,2
P4000	+2,0	+1,0	$\pm 0,3$	-0,2
P5000	+2,0	+1,0	$\pm 0,3$	-0,2

^a Determined by results of cooperative tests.

8 Test report

The test report shall comprise at least the following information:

- the sample;
- the lot number;
- a reference to this document, e.g. ISO 6344-4:2021;
- the test method;
- the result(s);
- specified limits according to [Table 1](#) (for microgrit sizes P240 to P1200) or [Table 6](#) (for microgrit sizes P1500 to P5000).

9 Designation

The designation of microgrit sizes for fused aluminium oxide or silicon carbide complying with the requirements of this document shall comprise the following:

- a) the type of abrasive or product name;
- b) the microgrit size, including the letter “P” for a coated abrasive product, followed by a characteristic number representing the grit size.

EXAMPLE A microgrit size designation is as follows:

Silicon carbide - P800

Type of abrasive

Microgrit size

10 Marking

Each of the smallest packing units shall be marked comprising the following:

- a) the name of manufacturer;
- b) the type of abrasive or product name;
- c) the microgrit size, including the letter “P” for a coated abrasive product, followed by a characteristic number representing the grit size;
- d) the lot number;
- e) handling instructions, hazard warnings, if applicable.

The marking shall be indelible and legible as long as possible.

The product(s) shall be accompanied by the test report in accordance with [Clause 8](#).

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Annex A (informative)

Theoretical equivalent grain diameters, d , for grits of fused aluminium oxide and for grits of silicon carbide

The theoretical equivalent grain diameter, d , is calculated as a function of time of sedimentation, t , when using methyl alcohol as sedimentation medium at test temperature 25 °C in [Table A.1](#) for aluminium oxide and [Table A.2](#) for silicon carbide.

Table A.1 — Theoretical equivalent grain diameter, d , for grits of fused aluminium oxide

t	d	t	d	t	d	t	d	t	d
min	µm	min	µm	min	µm	min	µm	min	µm
0,50	112,7	2,50	50,4	4,50	37,6	8,00	28,2	23,00	16,6
0,55	107,5	2,55	49,9	4,55	37,4	8,20	27,8	24,00	16,3
0,60	102,9	2,60	49,4	4,60	37,2	8,40	27,5	25,00	15,9
0,65	98,9	2,65	49	4,65	37	8,60	27,2	26,00	15,6
0,70	95,3	2,70	48,5	4,70	36,8	8,80	26,9	27,00	15,3
0,75	92	2,75	48,1	4,75	36,6	9,00	26,6	28,00	15,1
0,80	89,1	2,80	47,6	4,80	36,4	9,20	26,3	29,00	14,8
0,85	86,4	2,85	47,2	4,85	36,2	9,40	26	30,00	14,6
0,90	84	2,90	46,8	4,90	36	9,60	25,7	32,00	14,1
0,95	81,8	2,95	46,4	4,95	35,8	9,80	25,5	34,00	13,7
1,00	79,7	3,00	46	5,00	35,6	10,00	25,2	36,00	13,3
1,05	77,8	3,05	45,6	5,10	35,3	10,20	25	38,00	12,9
1,10	76	3,10	45,3	5,20	35	10,40	24,7	40,00	12,6
1,15	74,3	3,15	44,9	5,30	34,6	10,60	24,5	42,00	12,3
1,20	72,8	3,20	44,6	5,40	34,3	10,80	24,2	44,00	12
1,25	71,3	3,25	44,2	5,50	34	11,00	24	46,00	11,8
1,30	69,9	3,30	43,9	5,60	33,7	11,20	23,8	48,00	11,5
1,35	68,6	3,35	43,5	5,70	33,4	11,40	23,6	50,00	11,3
1,40	67,4	3,40	43,2	5,80	33,1	11,60	23,4	55,00	10,8
1,45	66,2	3,45	42,9	5,90	32,8	11,80	23,2	60,00	10,3
1,50	65,1	3,50	42,6	6,00	32,5	12,00	23	65,00	9,9
1,55	64	3,55	42,3	6,10	32,3	12,50	22,5	70,00	9,5
1,60	63	3,60	42	6,20	32	13,00	22,1	75,00	9,2
1,65	62,9	3,65	41,7	6,30	31,8	13,50	21,7	80,00	8,9
1,70	61,1	3,70	41,4	6,40	31,5	14,00	21,3	85,00	8,6
1,75	60,2	3,75	41,2	6,50	31,3	14,50	20,9	90,00	8,4
1,80	59,4	3,80	40,9	6,60	31	15,00	20,6	95,00	8,2
1,85	58,6	3,85	40,6	6,70	30,8	15,50	20,2	100,00	8
1,90	57,8	3,90	40,4	6,80	30,6	16,00	19,9	105,00	7,8
1,95	57,1	3,95	40,1	6,90	30,3	16,50	19,6	110,00	7,6
2,00	56,4	4,00	39,9	7,00	30,1	17,00	19,3	115,00	7,4