INTERNATIONAL STANDARD

ISO 8876

First edition
1989-10-01

Fluorspar — Determination of particle size distribution by sieving

Spaths fluor — Analyse granulométrique par tamisage

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ISO 8876:1989
https://standards.iteh.ai/catalog/standards/sist/47498418-8afb-47f9-8ca5-d7c4980f109f/iso-8876-1989

Reference number
ISO 8876 : 1989 (E)

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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International Standard ISO 8876 was prepared by Technical Committee ISO/TC 175, *Fluorspar.*

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Annexes A and B of this International Standard are for information only.

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Fluorspar — Determination of particle size distribution by sieving

1 Scope

This International Standard specifies sieving procedures to be employed for the determination of the particle size distribution of fluorspar.

The particle size distribution is expressed in terms of the percentage mass of fluorspar which passes through or is retained on selected sieves.

Annexes A and B show examples of sieving apparatus.

The purpose of this International Standard is to provide a basic method for the determination of the particle size distribution of fluorspar which may be used by contracting parties in the sale and purchase of this material.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 565 : 1983, *Test sieves — Woven metal wire cloth, perforated plate and electroformed sheet — Nominal sizes of openings.*

ISO 2591-1 : 1988, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate.*

ISO 3310-1 : 1982, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth.*

ISO 3310-2 : 1982, *Test sieves — Technical requirements and testing — Part 2: Test sieves of metal perforated plate.*

ISO 8868 : 1989, *Fluorspar — Sampling and sample preparation.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 charge: A sample of fluorspar to be treated simultaneously on an individual sieve or on a nest of test sieves.

3.2 particle: Discrete coherent body of fluorspar of any size.

3.3 particle size (as determined by sieving): The size range according to which a particle is classified, i.e. the size of the smallest sieve opening through which a particle will pass if presented in the most favourable attitude and the size of the largest sieve opening on which the particle is retained.

3.4 nominal top size: Particle size corresponding to the size of the opening of the sieve on which approximately 5 % (m/m) of the fluorspar charge is retained.

3.5 particle size distribution: The quantitative grouping of particles in the sample according to particle size. It is expressed in terms of the percentage mass of particles which pass through or are retained on selected sieves in relation to the total mass of the sample.

3.6 particle size fraction: The portion of the charge separated by one sieve or two sieves with different opening sizes.

3.7 oversize fraction: The portion of the charge which does not pass through the coarsest sieve in the test, e.g. + w_A mm (or µm).

3.8 undersize fraction: The portion of the charge which passes through the finest sieve in the test, e.g. − w_c mm (or µm).

3.9 intermediate particle size fraction: The portion of the sample specified by the smallest sieve opening, e.g. w_A mm (or

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µm), through which the fraction has passed together with the size of the largest sieve opening, e.g. w_B mm (or µm), on which the fraction is retained in the test, e.g. $-w_A + w_B$ mm (or µm).

3.10 specification particle size: Any sieve size (or sizes) selected by the interested parties to define the limit (or limits) of the particle size fraction considered by them to be significant.

3.11 bulk density: The mass in air of a unit volume of fluorspar, including the voids within and between particles, expressed as mass units per unit volume, e.g. kilograms per cubic metre.

3.12 sieve: An apparatus for the purpose of sieving, consisting of a sieving medium mounted in a frame.

3.13 sieving medium: A surface containing regularly arranged openings of uniform shape and size.

3.14 specification sieve: Sieve having an opening size corresponding to the specification particle size (see 3.10).

3.15 sieving: Process of separating a mixture of particles, according to their size, by means of one or more sieves.

NOTE — When sieves are fitted together to form a nest of sieves, the term "nest sieving" may be used.

3.16 hand placing: A sieving operation in which particles are presented individually and by hand to the sieve openings and oriented until either they can be passed through without force being applied or they can be clearly classified as oversize.

3.17 hand sieving: Sieving operation in which the sieve or sieves are supported and agitated manually.

3.18 assisted hand sieving: Sieving operation in which the sieve or sieves are supported mechanically, but are agitated manually.

3.19 mechanical sieving: Sieving operation in which the sieves are supported and agitated by mechanical means. This operation may be either batch or continuous sieving.

3.20 batch sieving: Sieving operation in which a specific quantity of fluorspar is presented to one or more sieves which are agitated either by hand or by mechanical means. Characteristically, the resulting products are retained within the frame of the sieve or sieves until the end of the operation is reached. The number of presentations of particles to the openings is dependent on the length of sieving time (see annex A).

3.21 continuous sieving: A sieving operation in which the fluorspar is fed continuously onto one or several consecutive sieving media over which it travels (e.g. by virtue of the sieving medium being agitated, rotated and/or inclined). The products are continuously discharged. (See annex B.)

4 Principles of sieving

4.1 Planning

Before a particle size determination is carried out, it is necessary to plan the entire sequence of procedures to be followed. The sequence of procedures will depend on

a) the fluorspar to be evaluated, e.g. a visual examination of the particle size distribution of the sample may be made;

b) the form in which the fluorspar is received (i.e. as separate increments or as partial samples or the gross sample);

c) the apparatus available;

d) the purpose of the analysis.

A typical decision tree to enable the sequence of procedures to be formulated is shown in figure 1.

Sieving shall be carried out under controlled conditions strictly in accordance with ISO 2591-1.

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4.2 Selection of sieving operation

The final sieving operation used shall be based on one of the following procedures:

a) sieving of the complete particle size sample;

b) sieving separately of each increment or each partial sample or the gross sample.

Each user should consider the respective merits of these two operations in relation to the available apparatus and the quantity of sample to be processed.

4.3 Determination of sieving method

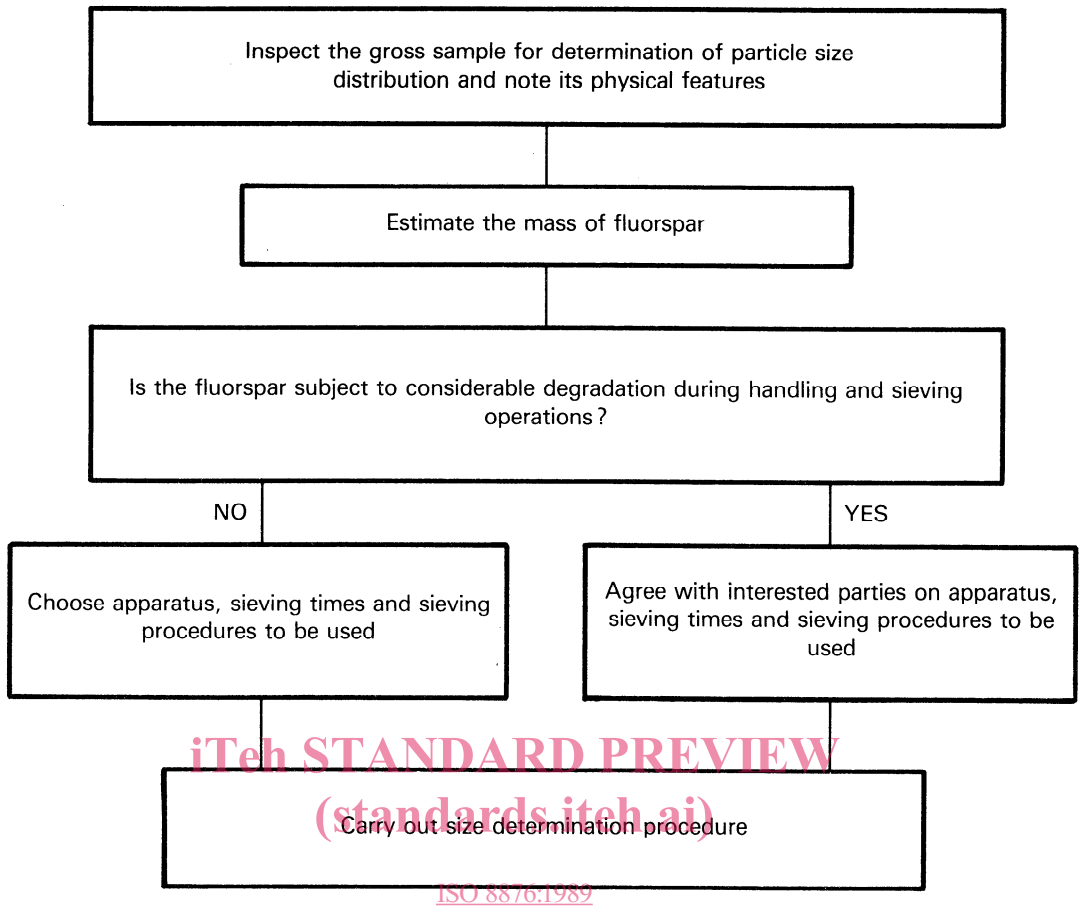
To decide whether the determination of the particle size distribution should be carried out using a manual or a mechanical sieving method, account should be taken of the state of the sample, e.g. its mass, and the number of determinations constituting the sieving operation selected.

4.4 Choice of apparatus

The equipment should be chosen from that available according to the mass (4.6.2) and particle size (4.6.1) of the fluorspar to be sieved.

4.5 Accuracy of sieving operation

For all sieving methods except mechanical sieving, the sum of the fractional masses of each operation should not differ by more than 1 % from the mass of the input to the operation.



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NOTE — The example illustrates one particle size determination and assumes that all increments or partial samples have been combined to produce one gross particle size sample.

Figure 1 — Typical decision tree for selecting particle size determination procedure

4.6 Sieve loading

4.6.1 Nominal top size permitted on a sieve

In order to avoid damage to sieves, the nominal top size of any particle permitted on a particular sieve shall be determined as follows.

Reference shall be made to the R 20 series given in ISO 565 and the nominal size of the opening of the sieve concerned shall be noted. The nominal top size of any particle permitted on such a sieve shall not be larger than the nominal size of the opening which is listed on the R 20 series four sizes above that of the sieve concerned. Examples of the relationship between the size of opening and the nominal top size are given in table 1.

Table 1 — Nominal top size permitted on a sieve

Dimensions in millimetres

Nominal opening size	Nominal top size
25	40
11,2	18
4	6,3

4.6.2 Specific loading of sieves

4.6.2.1 Openings larger than or equal to 22,4 mm

To obtain good sieving efficiency, the loading of the sieve shall be such that the maximum mass of fluorspar retained at the

completion of sieving on any sieve in this size range shall be in accordance with equation (1):

$$m_1 = 2(0{,}005 + 0{,}000\,4\,w)\varrho_b A \quad \ldots (1)$$

where

m_1 is the maximum mass of charge, which is tabulated in table 2 according to the sieve opening size, in kilograms;

w is the nominal opening size, in millimetres;

ϱ_b is the bulk density of fluorspar, in kilograms per cubic metre;

A is the area of the sieve, in square metres.

4.6.2.2 Openings smaller than 22,4 mm and larger than or equal to 500 µm

To obtain good sieving efficiency, the load on the sieve shall be such that the maximum mass of the fluorspar retained at the completion of sieving on any sieve in this size range shall be in accordance with equation (2):

$$m_2 = 0{,}001\,7\,w\varrho_b A \quad \ldots (2)$$

where

m_2 is the maximum mass of charge, which is tabulated in table 2 according to the sieve opening size, in kilograms;

w, ϱ_b and A are as specified for equation (1).

4.7 Sieving time

The sieving time is influenced mainly by the characteristics of the fluorspar, the volume of the initial charge and the nominal opening size of the sieve.

For the purposes of this International Standard, the end point of the sieving process is specified as that point when the quantity of material passing through the sieve in 1 min is less than 0,2 % of the mass of the charge.

If an end point is not reached within 6 min, an arbitrary sieving time shall be agreed upon by the interested parties.

The examples shown in table 3 are given as a general indication of sieving times of gravel of metallurgical-grade fluorspar.

Table 3 — Examples of sieving times for gravel, using batch methods

Sieve nominal opening size, w mm	Time min	
	Hand sieving	Mechanical sieving
$w \geqslant 4$	3	3
$4 > w \geqslant 1$	Variable	5

5 Apparatus

5.1 Sieving media

5.1.1 Shape of opening

The sieving media shall have square openings in accordance with ISO 565.

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5.1.2 Size of opening

The nominal size of opening to be utilized shall be selected from the R 20 series as specified in ISO 565.

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5.1.3 Construction

The construction of the sieving media shall be in accordance with ISO 565, ISO 3310-1 and ISO 3310-2.

5.2 Sieve frames

5.2.1 Shape and size

Sieves used for hand or mechanical nest sieving shall have frames in accordance with ISO 2591-1. Frames may be either round or rectangular in shape.

Table 2 — Examples of sieve opening size and maximum mass of charge

Sieve nominal opening size for the following types of sieving media mm		Maximum mass of charge for the following types of sieve frame kg		
Perforated plate	Woven metal, wire cloth	Round frame, ϕ 200 mm	Square frame, 450 mm × 450 mm	Square frame, 600 mm × 600 mm
200				30
140				30
100				30
50	50		15	30
31,5	31,5		10	20
10	10		4	8
5,6	5,6	0,5	3	5
5	5	0,4	2	4

5.2.2 Construction

The sieve frames shall be of the same type and shall nest snugly with each other. The frame should be smooth and the seals of the sieves so constructed as to avoid lodging of the material and loss of fines. (See annex A.)

5.3 Sieving machines

Any type of apparatus is acceptable provided that the results obtained with reference to the specification particle size selected, or other opening size as agreed upon, are within ± 2 % of the mass of those obtained using hand-placing or hand-sieving methods carried out under closely controlled conditions in accordance with ISO 2591-1. (See annex B.)

5.4 Equipment for the determination of mass

Each device for the determination of mass shall have a sensitivity of at least 0,1 % of its rated capacity and a level of accuracy sufficient to permit the mass of the test portion and of each size fraction to be determined to a precision of ± 0,1 % or better of the mass of the test portion. However, the sensitivity of the weighing device shall be 0,5 % or better for the hopper scale.

An alternative method is to compare the performance of the sieve with the performance of a reference sieve using the identical material with due allowance made for degradation.

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6 Maintenance of sieves

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The accuracy of the sieving media should be verified initially and verification should be repeated regularly during use. Factors such as the frequency of use and the type of fluorspar sieved will influence the frequency of verification. It is recommended that a record card be kept for each sieve. Verification shall be made using the procedures specified in ISO 3310-1 and ISO 3310-2.

7 Test sample for particle size determination

Test samples shall be taken and prepared in accordance with ISO 8868.

8 Sieving procedure

8.1 Test sieving by hand and hand placing

This method should be applied to any size of fluorspar which can be conveniently handled.

8.1.1 Gently shake the sieves by hand until screening is complete.

8.1.2 Check the fluorspar particles remaining on the sieve one by one in all orientations without applying force. Those particles that pass through the sieve openings are included in the passing fraction; those that do not pass through are the residue.

8.2 Hand sieving and assisted hand sieving

Hand sieving and assisted hand sieving should, as a rule, commence with the sieve with the largest opening size and progress in descending order of opening size.

8.2.1 Sieving procedure for coarse fluorspar (sieve openings of 11,2 mm and larger)

a) The mass of a charge to be placed on a sieve at one time shall not exceed that shown in table 2.

b) Take the sieve with both hands and move it to and fro horizontally about 120 times a minute at an amplitude of approximately 70 mm.

c) The sieving operation is complete when almost no fluorspar particles pass through the sieve.

d) The end point of the sieving process is specified as that point when the quantity of material passing through the specification sieve in 1 min is less than 0,1 % of the mass of the charge.

e) Strict application of the end-point ruling may be inconvenient and it will then be more practicable to use arbitrary sieving times determined by experience. In such a case, procedures c) and d) can be omitted.

f) When sieving of a test sample is completed, weigh each of the separated particle size fractions of the sample individually.

8.2.2 Sieving procedure for fine fluorspar (sieve openings from 11,2 mm to 1 mm)

a) The mass of a charge to be placed on a sieve at one time shall not exceed that shown in table 2.

b) Take the sieve or the nest of sieves with both hands and move it to and fro horizontally about 120 times a minute at an amplitude of approximately 70 mm.

c) Apply the end-point ruling specified in 8.2.1.

Figure 2 illustrates two alternative methods for using individual sieves for fluorspar of particle size −11,2 mm, +1 mm.

8.3 Test sieving by machine

Test sieving by means of a mechanical sieving machine shall be carried out as described below.

8.3.1 Continuous-type mechanical sieving machines

The mass of a charge shall be selected taking into account the area of the sieving medium, the rate at which the sample passes through the sieve and the properties of the fluorspar.

8.3.2 Non-continuous-type mechanical sieving machines

Any batch-type shaking machine fitted with either a single sieve or a nest of sieves of several different aperture sizes may be