INTERNATIONAL STANDARD

# ISO 3252

Sixth edition
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# Powder metallurgy — Vocabulary

*Métallurgie des poudres — Vocabulaire*

Reference number
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# Foreword

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This document was prepared by Technical Committee ISO/TC 119, *Powder metallurgy,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS M11, *Powder metallurgy,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This sixth edition cancels and replaces the fifth edition (ISO 3252:2019), which has been technically revised.

The main changes are as follows:

— several new definitions and figures related to forming (3.2) have been added.

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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# Introduction

The terms are classified alphabetically under the following categories:

— powders;

— forming;

— sintering and characteristics of sintered materials;

— post-sintering treatments;

— powder metallurgy materials.

NOTE Additional information on certain terms defined can be found in the standards given in Notes to entry. These are listed in the Bibliography.

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# Powder metallurgy — Vocabulary

## 1 Scope

This document defines terms related to powder metallurgy.

Powder metallurgy is the branch of metallurgy which relates to the manufacture of metallic powders, or of articles made from such powders with or without the addition of non-metallic powders, by the application of forming and sintering processes.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

ISO and IEC maintain terminological 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 Terms related to powders

**3.1.1**
**acicular**, adj.
needle-like particle form

Note 1 to entry: See Figure 1.

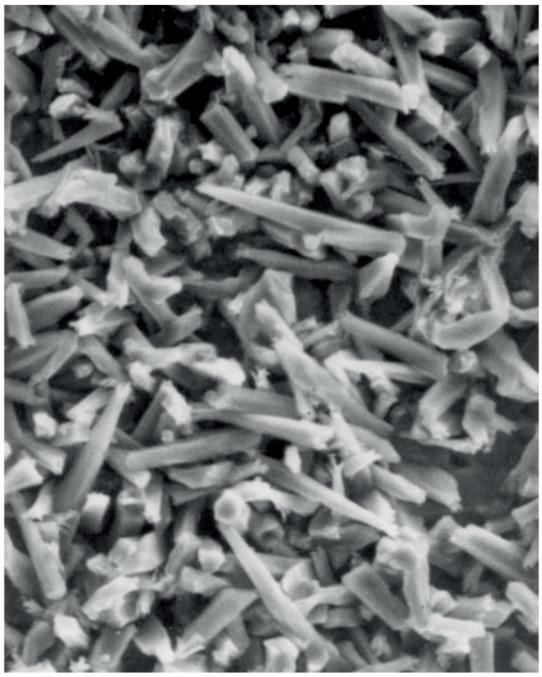

**Figure 1 — Acicular**

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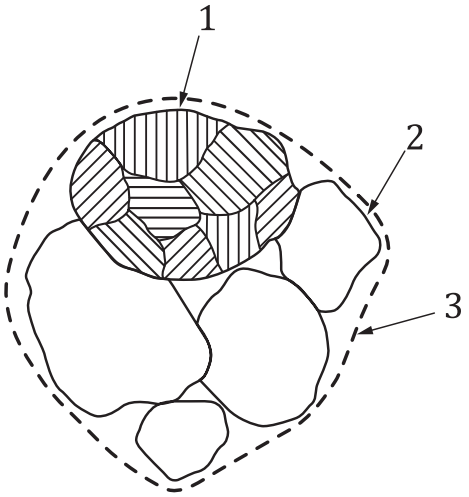
**3.1.2**
**agglomerate**
several particles adhering together

Note 1 to entry: See Figure 2.




**Key**

1 grain
2 particle
3 agglomerate

**Figure 2 — Diagramatic representation of grain, particle and agglomerate**

**3.1.3**
**alloyed powder**
metal powder consisting of at least two constituents that are partially or completely alloyed with each other

**3.1.4**
**angle of repose**
basal angle of a pile formed by a powder when freely poured under specified conditions on to a horizontal surface

**3.1.5**
**angular**, adj.
sharp-edged or roughly polyhedral

Note 1 to entry: See Figure 3.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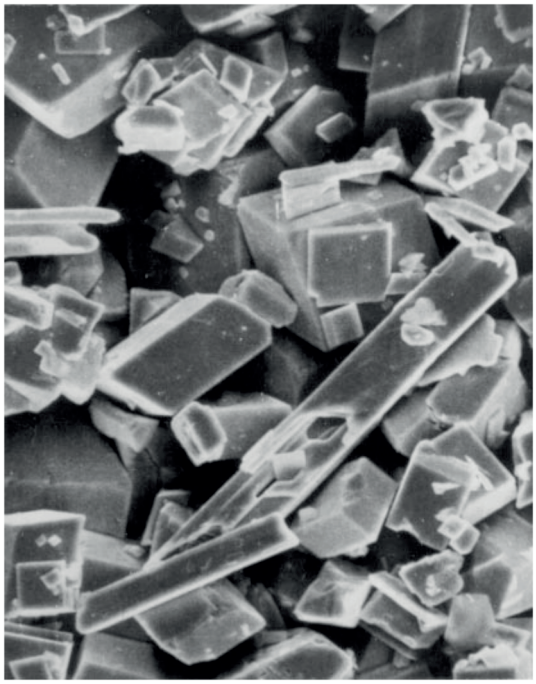

**Figure 3 — Angular**

**3.1.6**
**apparent density**
mass per unit volume of a powder obtained following specific methods

Note 1 to entry: For example, ISO 3923-1 related to free-flowing powders and ISO 3923-2 related to non-free-flowing powders.

**3.1.7**
**atomization**
dispersion of a molten metal into particles by a rapidly moving gas or liquid stream or by mechanical means

[SOURCE: ASTM B243-17]

**3.1.8**
**atomized metal powder**
metal powder produced by *atomization* (3.1.7)

**3.1.9**
**binder**
material added to the powder mix to increase the *green strength* (3.2.48) of the compact or to counteract dusting and *segregation* (3.1.75) of fine particulate mix constituents, and which is expelled during sintering

Note 1 to entry: In hard metals, it is also used for material (binder metal, usually of lower melting point) added to a powder mixture for the specific purpose of cementing together powder particles which alone would not sinter into a strong body.

Note 2 to entry: Cementing medium is also used in the field of hard metals.

**3.1.10**
**blended powder**
powder made by *blending* (3.1.11)

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**3.1.11**
**blending**
thorough intermingling of powders of the same nominal composition

Note 1 to entry: Not to be confused with *mixing* (3.1.53).

**3.1.12**
**bridging**
formation of arched cavities in a powder mass

**3.1.13**
**bulk density**
mass per unit volume of a powder under nonstandard conditions

**3.1.14**
**cake**
bonded mass of unpressed metal powder

EXAMPLE The condition of a powder mass as it exits an annealing furnace.

**3.1.15**
**carbonyl powder**
powder produced by the thermal decomposition of a metal carbonyl

**3.1.16**
**chill-block cooling**
process for producing rapidly solidified powders by cooling a thin layer of molten material on a solid substrate

**3.1.17**
**chopped powder**
powder produced by chopping material such as sheet, ribbon, fibre or filament

**3.1.18**
**classification**
separation of powder into fractions according to particle size

**3.1.19**
**coated powder**
powder consisting of particles having a surface layer of different composition

**3.1.20**
**comminuted powder**
powder produced by mechanical disintegration of solid metal

**3.1.21**
**compactability**
encompassing the powder characteristics of *compressibility* (3.1.24), *green strength* (3.2.48), edge retention, and lamination tendency, that relates to the ability of a powder to be consolidated into a usable *green compact* (3.2.11)

Note 1 to entry: Compactability is a conceptual term and may be a function of flowability, compressibility and green strength.

**3.1.22**
**completely alloyed powder**
*alloyed powder* (3.1.3) in which each powder particle has a homogeneous chemical composition being that of the entire powder

**3.1.23**
**composite powder**
powder in which each particle consists of two or more different constituents


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**3.1.24**
**compressibility**
capacity of a powder to be densified under an uniaxially applied pressure

Note 1 to entry: The pressure applied is usually a uniaxial pressure in a closed die. Compressibility may be expressed as the pressure needed to reach a required density or as the density obtained at a given pressure.

Note 2 to entry: See ISO 3927.

**3.1.25**
**compression ratio**
ratio of the volume of the loose powder to the volume of the compact made from it

**3.1.26**
**cut**
fraction of a powder nominally within stated particle size limits

**3.1.27**
**dehydrided powder**
powder made by removal of hydrogen from metal hydride

**3.1.28**
**demixing**
loss of homogeneity of a powder mix due to excessive mixing time

**3.1.29**
**dendritic**, adj.
branch-shaped

Note 1 to entry: See Figure 4.

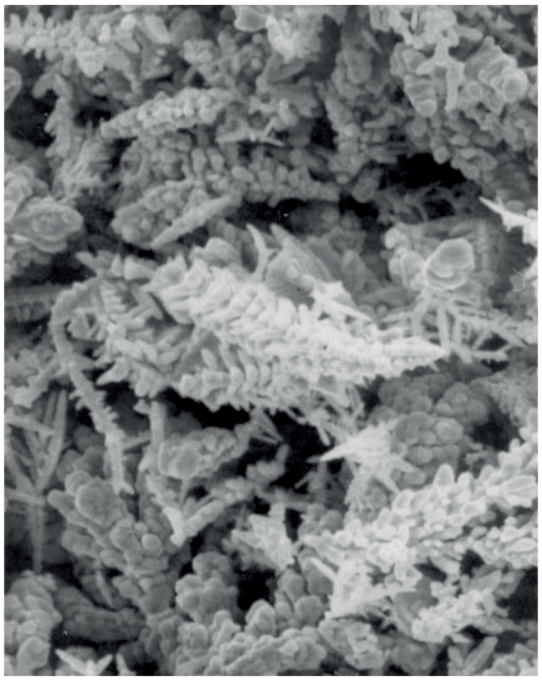

**Figure 4 — Dendritic**

**3.1.30**
**diffusion-alloyed powder**
partially *alloyed powder* (3.1.3) produced by means of a thermal process involving diffusion

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**3.1.31**
**dopant**
substance added in small quantity to a metallic powder to prevent or control recrystallization or grain growth either during *sintering* (3.3.60) or during use of the resultant sintered object

Note 1 to entry: This term is especially used in the powder metallurgy of tungsten.

**3.1.32**
**electrolytic powder**
powder produced by an electrolytic process

**3.1.33**
**elutriation**
*classification* (3.1.18) of a powder through movement of the particles through a fluid medium

EXAMPLE Air classification and liquid classification.

**3.1.34**
**feedstock**
mouldable mixture of metal powder and *binder* (3.1.9) used for injection moulding or powder extrusion

**3.1.35**
**fibrous**, adj.
having the appearance of regularly or irregularly shaped threads

Note 1 to entry: See Figure 5.

**Figure 5 — Fibrous**

**3.1.36**
**fill factor**
<uniaxial pressing> ratio of the height to which a powder fills a die to the height of the compact, measured after ejection from the die

**3.1.37**
**fines**
fraction of a powder that passes through the smallest sieve size used in the *sieve analysis* (3.1.76)


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**3.1.38**
**flaky**, adj.
plate-like particle form

Note 1 to entry: See Figure 6.

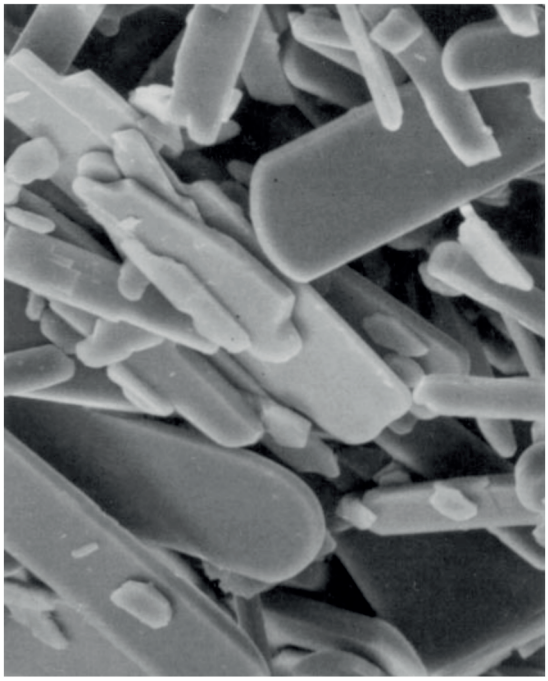

**Figure 6 — Flaky**

**3.1.39**
**flowability**
<qualitative term> behaviour of a powder when flowing through a funnel of defined dimension

Note 1 to entry: See ISO 4490 and ISO 13517.

**3.1.40**
**flowmeter**
standardized funnel and cylindrical cup used for the determination of *apparent density* (3.1.6) and *flow rate* (3.1.41)

Note 1 to entry: For apparent density see ISO 3923-1 and ISO 3923-2.

Note 2 to entry: For flow rate see ISO 4490 and ISO 13517.

**3.1.41**
**flow rate**
time required for a powder sample of standard weight to flow through an orifice in a standard instrument according to a specified procedure

[SOURCE: ASTM B243-17]

**3.1.42**
**granular**, adj.
approximately equidimensional non-spherical shape

Note 1 to entry: See Figure 7.

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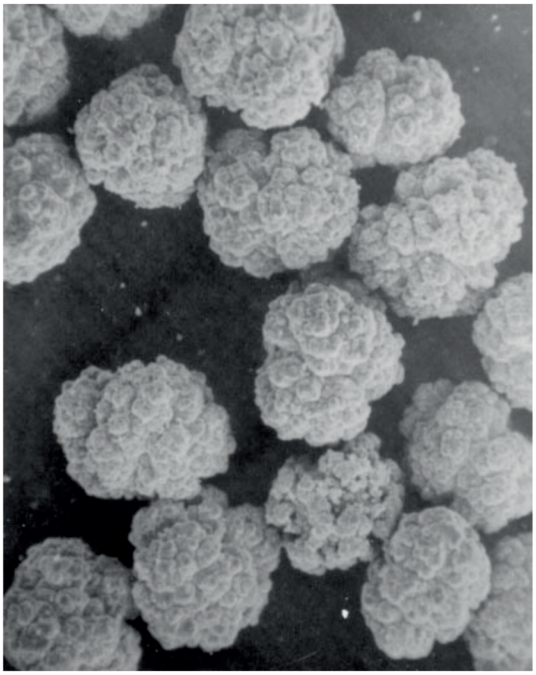

**Figure 7 — Granular**

**3.1.43**
**granulation**
agglomeration of fine particles to obtain a coarser powder with improved flowability

**3.1.44**
**hydrogen loss**
loss in weight of metal powder or of a compact caused by heating a representative sample for a specified time and temperature in a purified hydrogen atmosphere

Note 1 to entry: Broadly, a measure of the oxygen content of the sample when applied to materials containing only such oxides as are reducible with hydrogen and no hydride forming element. See also ISO 4491-2.

**3.1.45**
**hydrogen-reducible oxygen**
oxygen content of a powder emanating from oxygen-bearing constituents reduced by hydrogen under standardized conditions

Note 1 to entry: See also ISO 4491-3.

**3.1.46**
**irregular**
lacking any symmetry

Note 1 to entry: See Figure 8.


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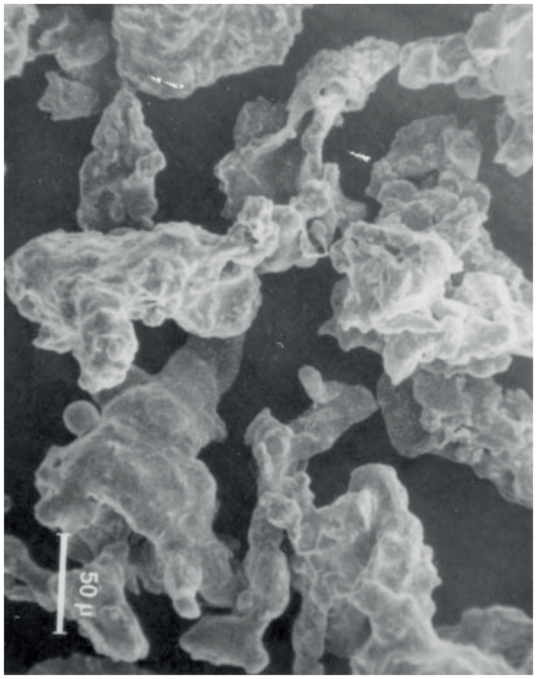


**Figure 8 — Irregular**

**3.1.47**
**lubricant**
material used to reduce inter-particle friction and the friction between the powder mass and the tooling

**3.1.48**
**master alloy powder**
*alloyed powder* (3.1.3) containing a relatively high concentration of one or more elements that may be difficult to introduce in their unalloyed states

Note 1 to entry: The master alloy powder is mixed with other powders to produce the required final composition.

**3.1.49**
**mechanical alloying**
process of alloying in the solid state by high-energy attritor or ball-mill

**3.1.50**
**mechanically alloyed powder**
*composite powder* (3.1.23) produced by mechanically incorporating other constituents which are generally insoluble within the deformable particles of the matrix metal

**3.1.51**
**milling**
mechanical treatment of metal powder, or metal powder mixtures, as in a ball mill, to alter the size or shape of the individual particles or to coat one component of the mixture with another

**3.1.52**
**mixed powder**
powder made by mixing powders, where the constituent powders differing in composition

**3.1.53**
**mixing**
thorough intermingling of powders of two or more materials

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