
British Standard

Powder metallurgical materials and products

Part 1. General information
Section 1.2 Glossary of terms

Matières premières et produits de la métallurgie des poudres
Partie 1. Généralités
Section 1.2 Glossaire des termes

Pulvermetallurgische Werkstoffe und Erzeugnisse
Teil 1. Allgemeines
Abschnitt 1.2 Glossar der Begriffe

Foreword

This Section of BS 5600 is based upon the final Committee draft (document ISO/TC119/SC1 N97) for the revision of ISO 3252-1975 'Powder metallurgy — Vocabulary' published by the International Organization for Standardization (ISO).

This Section is one of a series that comprises BS 5600. A list of Sections of BS 5600 appears in table 1 of the introduction and contents (Section 1.1).

Scope

This British Standard gives definitions of terms relating to powder metallurgy.

The terms are classified under the following main headings:

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|------------------|-----------------------------------|
| 1. General terms | 4. Sintering |
| 2. Powders | 5. Post-sintering treatments |
| 3. Forming | 6. Powder metallurgical materials |

An alphabetical index of the terms defined is also given.

No.	Term	Definition
1. General terms		
1001	powder metallurgy*	That part 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.
1101	binder	A substance added to a powder primarily to increase the green strength of a compact or to prevent demixing of the powder and which is expelled before or during sintering.
1102	binder phase	A phase in a heterogeneous sintered material that binds together the other phases.
1103	binder metal	A metallic binder phase that has a lower melting point than the other phases of a heterogeneous sintered material.
1201	dope	A substance added in small quantity to a metallic powder to prevent or control recrystallization or grain growth either during sintering or during use of the resultant sintered object. The term is especially used in the powder metallurgy of tungsten.
1301	density	Mass divided by volume. The volume also includes the volume of voids in the material.
1302	relative density	The ratio, usually expressed as a percentage, of the density of a porous object to the density of the material of the same composition in the pore-free state.
1303	solid density	The density of the solid phase constituting the porous material. It is also the density of the same material in the non-porous state.
1304	presintered density	The density of an object in the presintered state.
1305	sintered density	The density of an object in the sintered state.
1306	density distribution	The quantification of any density variation existing within a compact or sintered object.
1401	pore	An inherent or induced cavity within a particle or within an object.
1402	open pore	A pore communicating with the surface.
1403	closed pore	A pore not communicating with the surface.
1404	communicating pores	Interconnected pores; they may be open or closed.
1405	porosity	The ratio of the volume of all the pores to the total volume of a porous object.
1406	open porosity	The ratio of the volume of the open pores to the total volume of a porous object.
1407	closed porosity	The ratio of the volume of the closed pores to the total volume of a porous object.
1408	pore size distribution	The percentage by numbers or by volume of each classified pore size which exists in a material.
1409	apparent hardness	The hardness of a sintered object measured under specified conditions in such a way as to include the effects of porosity.
1410	solid hardness	The hardness of the solid material measured under specified conditions in such a way as to exclude the effects of porosity.
1501	blank	A compact or a presintered or sintered object of unfinished dimensions or shape.
1502	preform	A blank intended to be subject to hot or cold mechanical forming and densification.
1503	infiltration	The process of filling the pores of an unsintered or sintered object with a metal or alloy of lower melting point than that of the object.

*The acronyms PM and P/M are often used as in 'PM part', 'P/M product', 'PM process', etc.

No.	Term	Definition
2. Powders		
2001	powder	An assembly of particles usually less than 1 mm in size.
2002	particle	A unit of power that cannot readily be subdivided by the usual separation processes. The term 'grain' is not synonymous with particle and should be used in its normal metallurgical sense (see figure 2).
2101	atomized powder	A powder produced by mechanical dispersion of molten metals or alloys into particles, for example by means of a rapidly moving gas or liquid stream.
2102	carbonyl powder	A powder produced by the thermal decomposition of a metal carbonyl.
2103	comminuted powder	A powder produced by mechanical disintegration of solid metal.
2104	electrolytic powder	A powder produced by electrolytic deposition.
2105	precipitated powder	A powder produced by chemical precipitation from solution.
2106	reduced powder	A powder produced by chemical reduction of a solid metal compound.
2107	sponge powder	A porous, reduced powder produced by comminution of a metal sponge which is in itself a coherent, highly porous metal produced by reduction.
2108	alloyed powder	A metal powder consisting of at least two constituents that are partially or completely alloyed with each other.
2109	completely alloyed powder	An alloyed powder in which each powder particle has a homogeneous chemical composition being that of the entire powder.
2110	partially alloyed powder	An alloyed powder, the particles of which have not reached the completely alloyed state.
2111	pre-alloyed powder	An alloyed powder usually made by atomization of a melt.
2112	master alloy powder	An alloyed powder containing a relatively high concentration of one or more elements that may be difficult to introduce in their unalloyed states. The master alloy powder is mixed with other powders to produce the required final composition after sintering.
2113	composite powder	A powder in which each particle consists of two or more different materials.
2114	mixed powder	A powder made by mixing two or more powders as uniformly as possible. The constituent powders will differ in chemical composition.
2201	acicular	Needle shaped (see figure 1).
2202	agglomerate	Several particles adhering together (see figure 2).
2203	angular	Sharp edged or roughly polyhedral (see figure 3).
2204	dendritic	Of branched shape (see figure 4).
2205	fibrous	Having the appearance of regularly or irregularly shaped threads (see figure 5).
2206	flaky	Platelike (see figure 6).
2207	granular	Approximately equidimensional but of irregular shape (see figure 7).
2208	irregular	Lacking any symmetry (see figure 8).
2209	nodular	Of rounded irregular shape (see figure 9).
2210	spheroidal	Roughly spherical (see figure 10).
2301	specific surface area (of a powder)	The total surface area of the particles per unit mass of powder.
2302	apparent density	The density of a powder obtained by free pouring under specified conditions.
2303	bulk density	The density of a powder under non-specified conditions, for example in shipping.

No.	Term	Definition
2304	tap density	The density of a powder in a container that has been tapped under specified conditions.
2305	angle of repose	The basal angle of a pile formed by a powder when freely poured under specified conditions onto a horizontal surface.
2306	flowability	Qualitative term describing the behaviour of a powder when flowing through an opening or a restricted space such as the opening in a die.
2307	flow time	The time required for a standard quantity of powder to flow through a standard orifice under specified conditions.
2308	fill factor (see also 2310)	The ratio of the height to which a powder fills a die to the height of the compact, measured after ejection from the die.
2309	compactibility curve compressibility curve	A plot of green density as a function of compacting pressure.
2310	compression ratio (see also 2308)	The ratio of the volume of uncompacted powder to the volume of the compact measured after ejection from the die.
2311	hydrogen loss	The relative loss in mass of a metal powder or compact caused by heating in an atmosphere of purified hydrogen under specified conditions.
2312	demixing segregation	The undesirable separation of one or more constituents of a powder mixture.
2401	blending	The thorough intermingling of powders of the same nominal composition.
2402	mixing	The thorough intermingling of powders of two or more different materials.
2403	milling	A general term for the mechanical treatment of powder, resulting in, for example: (a) modification of particle size or shape (comminution, agglomeration, etc.); (b) intimate mixing; (c) coating of the particles of one constituent with another constituent.
2404	granulation	Rendering a powder flowable by agglomerating smaller particles.
2501	classification	Separating a powder into fractions according to particle size.
2502	particle size distribution	The percentage by mass, or by numbers, or by volume of each fraction into which a powder sample has been classified with respect to size.
2503	elutriation	Classification of a powder by movement of the particles relative to a gas or rising liquid.
2504	cut	The fraction of a powder nominally within stated particle size limits.

3. Forming

3001	forming	A general term for any operation by which a powder is transformed into an object of prescribed shape and dimensions.
3101	pressing	A process in which a powder held in a container is subjected to an external force in order to produce a compact of prescribed shape and dimensions.
3102	powder rolling	A process in which a powder is introduced between a pair of rotating rolls which cause the powder to be compacted into a continuous coherent strip.
3201	tool set	An assembly of tooling items used for the production of a specific powder product by the process of compacting or repressing. The die set may include dies, punches and core rods but excludes press fittings common to more than one product (see appendix A).
3202	die	An item of a tool set that makes up the confining form in which the powder is pressed or repressed (see appendix A).

No.	Term	Definition
3203	mould*	A container in which powder is loosely packed and sintered, or cast as a slurry.
3204	floating die	A die that is able to move freely in the direction of pressing. Generally the die is supported by a spring.
3205	split die	A die made in two or more sections that are separated to remove the compact.
3206	segmented die	A die fabricated by the assembly of several die segments within a retaining bolster or shrink ring.
3207	punch	An item of a tool set used to apply pressure to the powder or object.
3208	core rod	An item of a tool set that forms an inner profile of a hollow or annular object (see appendix A).
3209	multiple die set	A tool set that produces two or more compacts on each pressing cycle.
3301	lubricant	A substance added to a powder to reduce the friction between particles and between the compact and the tool surfaces.
3302	fill	The quantity of powder required to charge a die.
3303	volume filling	The metering of a powder charge into a die by setting the depth of fill.
3304	weight filling	The metering of a powder charge into a die by weighing the powder.
3305	overfill system	A system of die filling in which, before filling commences, the lower punch is positioned to allow excess powder to enter the die; before removal of the feed shoe, the lower punch (and/or core rod) is moved to force excess powder back into the feed shoe, ensuring good fill (see figure 11).
3306	underfill system	A system of die filling in which, after filling of the die and removal of the feed shoe, the lower punch is retracted to transfer powder to a lower level in the die, avoiding spillage of powder when processing commences (see figure 12).
3307	bridging	The jamming or keying of particles which results in an abnormally large cavity.
3401	single-action pressing	A method by which a powder is pressed in a die between one moving and one fixed punch.
3402	double-action pressing	A method by which a powder is pressed in a die between opposing moving punches.
3403	multiple pressing	A method of pressing whereby two or more compacts are produced simultaneously in separate die cavities.
3404	hot pressing	The pressing of a powder or a compact at elevated temperature.
3405	uniaxial pressing	To press a powder in such a manner that the applied force is along a single axis.
3406	isostatic pressing	The pressing of a powder or compact by subjecting it to nominally equal pressure from every direction.
3407	hot isostatic pressing	The pressing of a powder, compact or sintered object by subjecting it, at elevated temperature, to nominally equal pressure from every direction.
3408	wet bag pressing	A method of cold isostatic pressing whereby the flexible bag containing the powder or compact is immersed in the pressure-transmitting fluid.
3409	dry bag pressing	A method of cold isostatic pressing whereby the flexible bag in which the powder or compact is placed is permanently mounted in the pressure vessel.
3410	encapsulation	Enclosing a powder or compact in a thin-walled closed container.
3411	canning	Encapsulation in a metallic container.

*In North America the term 'mould (mold)' is used also to mean die.