

CPC COOPERATIVE PATENT CLASSIFICATION

B PERFORMING OPERATIONS; TRANSPORTING (NOTES omitted)

SHAPING

B22 CASTING; POWDER METALLURGY

B22F WORKING METALLIC POWDER; MANUFACTURE OF ARTICLES FROM METALLIC POWDER; MAKING METALLIC POWDER (making alloys by powder metallurgy C22C); APPARATUS OR DEVICES SPECIALLY ADAPTED FOR METALLIC POWDER

NOTES

1. This subclass covers the making of metallic powder only insofar as powder with specific physical characteristics is made.
2. In this subclass, the term "powder" includes somewhat larger particles which are worked, obtained or behave in a manner similar to powder, e.g. fibres.
3. In this subclass, the expression "metallic powder" covers:
 - powders consisting of metal particles;
 - powders consisting of coated metal particles;
 - powders consisting of metal-coated non-metallic particles;
 - mixtures of powders of the kinds mentioned above;
 - powders of the kinds mentioned above as the main component mixed with or containing non-metallic material, e.g. lubricating or binding agents or organic material.
4. {In this subclass, combination sets (C-Sets) are used. Detailed information about C-Sets construction and the associated syntax rules is found in the definitions for B22F.}

WARNINGS

1. The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:
B22F 3/035 covered by B22F 3/03
2. In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

1/00	Metallic powder; Treatment of metallic powder, e.g. to facilitate working or to improve properties	1/07	• Metallic powder characterised by particles having a nanoscale microstructure (nanosized particles B22F 1/054)
1/05	• Metallic powder characterised by the size or surface area of the particles	1/08	• Metallic powder characterised by particles having an amorphous microstructure
1/052	• • characterised by a mixture of particles of different sizes or by the particle size distribution	1/09	• {Mixtures of metallic powders}
1/054	• • Nanosized particles	1/10	• Metallic powder containing lubricating or binding agents; Metallic powder containing organic material
1/0545	• • • Dispersions or suspensions of nanosized particles	1/102	• • Metallic powder coated with organic material
1/0547	• • • {Nanofibres or nanotubes}	1/103	• • containing an organic binding agent comprising a mixture of, or obtained by reaction of, two or more components other than a solvent or a lubricating agent
1/0549	• • • {Hollow particles, including tubes and shells}	1/105	• • containing inorganic lubricating or binding agents, e.g. metal salts
1/0551	• • • {Flake form nanoparticles}	1/107	• • containing organic material comprising solvents, e.g. for slip casting
1/0553	• • • {Complex form nanoparticles, e.g. prism, pyramid, octahedron}	1/108	• • {Mixtures obtained by warm mixing}
1/056	• • • {Submicron particles having a size above 100 nm up to 300 nm}	1/12	• Metallic powder containing non-metallic particles (containing lubricating or binding agents or organic material B22F 1/10)
1/06	• Metallic powder characterised by the shape of the particles (nanosized particles B22F 1/054)	1/14	• Treatment of metallic powder (mixing with lubricating or binding agents or with organic material B22F 1/10)
1/062	• • Fibrous particles	1/142	• • Thermal or thermo-mechanical treatment
1/065	• • Spherical particles		
1/0655	• • • Hollow particles		
1/068	• • Flake-like particles		

1/145	. . Chemical treatment, e.g. passivation or decarburisation	3/105	. . by using electric current {other than for infrared radiant energy}, laser radiation or plasma (B22F 3/11 takes precedence){; by ultrasonic bonding (B22F 3/115 takes precedence)}
1/147	. . . {Making a dispersion}	2003/1051	. . . {by electric discharge}
1/148	. . Agglomerating	2003/1052	. . . {assisted by energy absorption enhanced by the coating or powder}
1/16	. Metallic particles coated with a non-metal (coated with lubricating or binding agents or with organic material B22F 1/10)	2003/1053	. . . {by induction}
1/17	. Metallic particles coated with metal	2003/1054	. . . {by microwave}
1/18	. Non-metallic particles coated with metal	3/11	. . Making porous workpieces or articles
3/00	Manufacture of workpieces or articles from metallic powder characterised by the manner of compacting or sintering; Apparatus specially adapted therefor (; Presses and furnaces)	3/1103	. . . {with particular physical characteristics}
3/001	. {Starting from powder comprising reducible metal compounds (making ferrous alloys starting from compounds C22C 33/0235)}	2003/1106	. . . . {Product comprising closed porosity}
3/002	. {Manufacture of articles essentially made from metallic fibres}	3/1109	. . . . {Inhomogenous pore distribution (composite layers of porous nature B22F 7/002)}
3/003	. {Apparatus, e.g. furnaces (in general F27B)}	3/1112	. . . . {comprising hollow spheres or hollow fibres}
3/004	. {Filling molds with powder (feeding material to presses in general B30B 15/302)}	3/1115	. . . . {comprising complex forms, e.g. honeycombs}
3/005	. {Loading or unloading powder metal objects (transport in general B65G)}	3/1118	. . . . {comprising internal reinforcements}
3/006	. {Amorphous articles}	3/1121	. . . {by using decomposable, meltable or sublimatable fillers}
3/007	. . {by diffusion starting from non-amorphous articles prepared by powder metallurgy}	3/1125	. . . . {involving a foaming process}
3/02	. Compacting only	2003/1128	. . . . . {Foaming by expansion of dissolved gas, other than with foaming agent}
2003/023	. . {Lubricant mixed with the metal powder}	2003/1131	. . . . . {Foaming in a liquid suspension and decomposition}
2003/026	. . {Mold wall lubrication or article surface lubrication}	3/1134	. . . . . {Inorganic fillers (carbonaceous or paper filler B22F 3/1121)}
3/03	. . Press-moulding apparatus therefor	3/1137	. . . . . {by coating porous removable preforms}
2003/031	. . . {with punches moving in different directions in different planes}	3/114	. . . {the porous products being formed by impregnation (B22F 3/1137, B22F 3/26 take precedence)}
2003/033	. . . {with multiple punches working in the same direction}	3/1143	. . . {involving an oxidation, reduction or reaction step}
3/04	. . by applying fluid pressure {, e.g. by cold isostatic pressing [CIP]}	3/1146	. . . {After-treatment maintaining the porosity (B22F 3/114 takes precedence)}
3/045	. . . {Semi-isostatic pressure}	3/115	. by spraying molten metal, i.e. spray sintering, spray casting
3/06	. . by centrifugal forces	3/12	. Both compacting and sintering (by forging B22F 3/17)
3/08	. . by explosive forces {(generating shock waves in general G10K 15/043)}	3/1208	. . {Containers or coating used therefor}
3/087	. . using high energy impulses, e.g. magnetic field impulses	3/1216	. . . {Container composition}
3/093	. . using vibrations {or friction}	3/1225	. . . . {Glass}
3/10	. Sintering only	3/1233	. . . . {Organic material}
3/1003	. . {Use of special medium during sintering, e.g. sintering aid}	3/1241	. . . . {layered}
3/1007	. . . {Atmosphere (B22F 3/1021 takes precedence)}	3/125	. . . {Initially porous container}
3/101	. . . . {Changing atmosphere}	3/1258	. . . {Container manufacturing}
2003/1014	. . . {Getter}	3/1266	. . . . {by coating or sealing the surface of the preformed article, e.g. by melting}
3/1017	. . {Multiple heating or additional steps (B22F 3/101 takes precedence)}	3/1275	. . . . {by coating a model and eliminating the model before consolidation}
3/1021	. . . {Removal of binder or filler (removal of binder from ceramics C04B 35/638)}	3/1283	. . . . {Container formed as an undeformable model eliminated after consolidation}
3/1025	. . . . {not by heating only}	3/1291	. . . . {Solid insert eliminated after consolidation}
3/1028	. . . {Controlled cooling}	3/14	. . simultaneously
2003/1032	. . {comprising a grain growth inhibitor}	2003/145	. . . {by warm compacting, below debinding temperature}
3/1035	. {Liquid phase sintering}	3/15	. . . Hot isostatic pressing
3/1039	. . {by reaction (B22F 3/001, B22F 3/23 take precedence)}	2003/153	. . . . {apparatus specific to HIP}
2003/1042	. . {with support for articles to be sintered}	3/156	. . . . {by a pressure medium in liquid or powder form}
2003/1046	. . . {with separating means for articles to be sintered}	3/16	. . in successive or repeated steps
		3/162	. . . {Machining, working after consolidation}

3/164	. . . {Partial deformation or calibration}	5/10	. of articles with cavities or holes, not otherwise provided for in the preceding subgroups
2003/166	. . . . {Surface calibration, blasting, burnishing, sizing, coining}	2005/103	. . {Cavity made by removal of insert}
3/168	. . . . {Local deformation}	5/106	. . {Tube or ring forms}
3/17	. by forging	5/12	. of wires {(of tubes B22F 5/10)}
3/172	. . {Continuous compaction, e.g. rotary hammering (with axial pressure and without reduction of section B22F 3/204)}	7/00	Manufacture of composite layers, workpieces, or articles, comprising metallic powder, by sintering the powder, with or without compacting {wherein at least one part is obtained by sintering or compression (application of coating layers by use of metal powders, see C23C)}
2003/175	. . {by hot forging, below sintering temperature}	7/002	. {of porous nature}
3/177	. . {Rocking die forging}	7/004	. . {comprising at least one non-porous part}
3/18	. by using pressure rollers	7/006	. . . {the porous part being obtained by foaming}
2003/185	. . {by hot rolling, below sintering temperature}	7/008	. {characterised by the composition}
3/20	. by extruding	7/02	. of composite layers {(B22F 7/002 takes precedence)}
2003/202	. . {with back pressure}	7/04	. . with one or more layers not made from powder, e.g. made from solid metal
3/204	. . {Continuous compaction with axial pressure and without reduction of section}	2007/042	. . . {characterised by the layer forming method}
2003/206	. . {Hydrostatic or hydraulic extrusion}	2007/045	. . . . {accompanied by fusion or impregnation}
2003/208	. . {Warm or hot extruding}	2007/047	. . . . {non-pressurised baking of the paste or slurry containing metal powder}
3/22	. for producing castings from a slip	7/06	. of composite workpieces or articles from parts, e.g. to form tipped tools {(B22F 7/002 takes precedence)}
3/222	. . {by freeze-casting or in a supercritical fluid}	7/062	. . {involving the connection or repairing of preformed parts}
3/225	. . {by injection molding}	7/064	. . . {using an intermediate powder layer}
3/227	. . {by organic binder assisted extrusion}	2007/066	. . . {using impregnation}
3/23	. involving a self-propagating high-temperature synthesis or reaction sintering step {(making cermets by reaction sintering C22C 1/051)}	2007/068	. . . {repairing articles}
3/24	. After-treatment of workpieces or articles {(B22F 3/1146 takes precedence)}	7/08	. . with one or more parts not made from powder {(B22F 7/062 takes precedence)}
2003/241	. . {Chemical after-treatment on the surface}	8/00	Manufacture of articles from scrap or waste metal particles
2003/242	. . . {Coating}	9/00	Making metallic powder or suspensions thereof
2003/244	. . . {Leaching}	2009/001	. {from scrap particles}
2003/245	. . {Making recesses, grooves etc on the surface by removing material}	9/002	. {amorphous or microcrystalline}
2003/247	. . {Removing material: carving, cleaning, grinding, hobbing, honing, lapping, polishing, milling, shaving, skiving, turning the surface}	9/004	. . {by diffusion, e.g. solid state reaction}
2003/248	. . {Thermal after-treatment}	9/005	. . . {Transformation into amorphous state by milling}
3/26	. . Impregnating {(making ferrous alloys by impregnation C22C 33/0242)}	9/007	. . {Transformation of amorphous into microcrystalline state}
5/00	Manufacture of workpieces or articles from metallic powder characterised by the special shape of the product	9/008	. . {Rapid solidification processing}
2005/001	. {Cutting tools, earth boring or grinding tool other than table ware}	9/02	. using physical processes
2005/002	. {Tools other than cutting tools}	9/023	. . {Hydrogen absorption}
5/003	. {Articles made for being fractured or separated into parts}	9/026	. . {Spray drying of solutions or suspensions}
2005/004	. {Article comprising helical form elements (B22F 5/085 takes precedence)}	9/04	. . starting from solid material, e.g. by crushing, grinding or milling ({ C22C 1/1084 takes precedence}; crushing, grinding or milling, in general, see the relevant subclasses, e.g. B02C)
2005/005	. {Article surface comprising protrusions}	2009/041	. . . {by mechanical alloying, e.g. blending, milling}
5/006	. {of flat products, e.g. sheets (B22F 3/1103 takes precedence; by using pressure rollers only see B22F 3/18)}	2009/042	. . . {using a particular milling fluid}
5/007	. {of moulds}	2009/043	. . . {by ball milling}
5/008	. {of engine cylinder parts or of piston parts other than piston rings (of piston rings B22F 5/02)}	2009/044	. . . {by jet milling}
5/009	. {of turbine components other than turbine blades (of turbine blades B22F 5/04)}	2009/045	. . . {by other means than ball or jet milling}
5/02	. of piston rings	2009/046	. . . . {by cutting}
5/04	. of turbine blades	2009/047	. . . . {by rolling}
5/06	. of threaded articles, e.g. nuts	2009/048	. . . {by pulverising a quenched ribbon}
5/08	. of toothed articles, e.g. gear wheels; of cam discs	2009/049	. . . {by pulverising at particular temperature}
5/085	. . {with helical contours}		

9/06	. . .	starting from liquid material	10/00	Additive manufacturing of workpieces or articles from metallic powder (apparatus or devices therefor B22F 12/00)
2009/065	. . .	{Melting inside a liquid, e.g. making spherical balls}	10/10	. . . Formation of a green body
9/08	. . .	by casting, e.g. through sieves or in water, by atomising or spraying (using electric discharge B22F 9/14)	10/12	. . . by photopolymerisation, e.g. stereolithography [SLA] or digital light processing [DLP]
2009/0804	. . . .	{Dispersion in or on liquid, other than with sieves}	10/14	. . . by jetting of binder onto a bed of metal powder
2009/0808	. . . .	{Mechanical dispersion of melt, e.g. by sieves}	10/16	. . . by embedding the binder within the powder bed
2009/0812	. . . .	{Pulverisation with a moving liquid coolant stream, by centrifugally rotating stream}	10/18	. . . by mixing binder with metal in filament form, e.g. fused filament fabrication [FFF]
2009/0816	. . . .	{by casting with pressure or pulsating pressure on the metal bath}	10/20	. . . Direct sintering or melting
9/082	. . . .	{atomising using a fluid (using centrifugal force B22F 9/10)}	10/22	. . . Direct deposition of molten metal
2009/0824	. . . .	{with a specific atomising fluid}	10/25	. . . Direct deposition of metal particles, e.g. direct metal deposition [DMD] or laser engineered net shaping [LENS]
2009/0828	. . . .	{with water}	10/28	. . . Powder bed fusion, e.g. selective laser melting [SLM] or electron beam melting [EBM]
2009/0832	. . . .	{Handling of atomising fluid, e.g. heating, cooling, cleaning, recirculating}	10/30	. . . Process control
2009/0836	. . . .	{with electric or magnetic field or induction}	10/31	. . . Calibration of process steps or apparatus settings, e.g. before or during manufacturing
2009/084	. . . .	{combination of methods}	10/32	. . . of the atmosphere, e.g. composition or pressure in a building chamber
2009/0844	. . . .	{in controlled atmosphere}	10/322	. . . of the gas flow, e.g. rate or direction
2009/0848	. . . .	{Melting process before atomisation}	10/34	. . . of powder characteristics, e.g. density, oxidation or flowability
2009/0852	. . . .	{Electroslag melting}	10/36	. . . of energy beam parameters
2009/0856	. . . .	{Skull melting}	10/362	. . . for preheating
2009/086	. . . .	{Cooling after atomisation}	10/364	. . . for post-heating, e.g. remelting
2009/0864	. . . .	{by oil, other non-aqueous fluid or fluid-bed cooling}	10/366	. . . Scanning parameters, e.g. hatch distance or scanning strategy
2009/0868	. . . .	{by injection of solid particles in the melt stream}	10/368	. . . Temperature or temperature gradient, e.g. temperature of the melt pool
2009/0872	. . . .	{by water}	10/37	. . . of powder bed aspects, e.g. density
2009/0876	. . . .	{by gas}	10/38	. . . to achieve specific product aspects, e.g. surface smoothness, density, porosity or hollow structures
2009/088	. . . .	{Fluid nozzles, e.g. angle, distance}	10/385	. . . {Overhang structures}
2009/0884	. . . .	{Spiral fluid}	10/39	. . . Traceability, e.g. incorporating identifier into a workpiece or article
2009/0888	. . . .	{casting construction of the melt process, apparatus, intermediate reservoir, e.g. tundish, devices for temperature control}	10/40	. . . Structures for supporting workpieces or articles during manufacture and removed afterwards
2009/0892	. . . .	{casting nozzle; controlling metal stream in or after the casting nozzle}	10/43	. . . characterised by material
2009/0896	. . . .	{particle transport, separation: process and apparatus}	10/47	. . . characterised by structural features
9/10	. . . .	using centrifugal force	10/50	. . . Treatment of workpieces or articles during build-up, e.g. treatments applied to fused layers during build-up
9/12	. . .	starting from gaseous material	10/60	. . . Treatment of workpieces or articles after build-up
9/14	. . .	using electric discharge	10/62	. . . by chemical means
9/16	. . .	using electric processes	10/64	. . . by thermal means (control of energy beam parameters for post heating B22F 10/364)
2009/165	. . .	{Chemical reaction in an Ionic Liquid [IL] (B22F 2009/245 takes precedence)}	10/66	. . . by mechanical means
9/18	. . .	with reduction of metal compounds	10/68	. . . Cleaning or washing
9/20	. . .	starting from solid metal compounds	10/70	. . . Recycling
9/22	. . . .	using gaseous reductors	10/73	. . . of powder
9/24	. . .	starting from liquid metal compounds, e.g. solutions	10/77	. . . of gas
2009/245	. . . .	{Reduction reaction in an Ionic Liquid [IL]}	10/80	. . . Data acquisition or data processing
9/26	. . . .	using gaseous reductors	10/85	. . . for controlling or regulating additive manufacturing processes
9/28	. . .	starting from gaseous metal compounds	12/00	Apparatus or devices specially adapted for additive manufacturing; Auxiliary means for additive manufacturing; Combinations of additive manufacturing apparatus or devices with other processing apparatus or devices
9/30	. . .	with decomposition of metal compounds, e.g. by pyrolysis	12/10	. . . Auxiliary heating means
9/305	. . .	{of metal carbonyls}		

12/13	. . to preheat the material	2201/40	. Metal compounds
12/17	. . to heat the build chamber or platform	2201/50	. air
12/20	. Cooling means	2202/00	Treatment under specific physical conditions
12/22	. {Driving means}	2202/01	. Use of vibrations
12/222	. . {for motion along a direction orthogonal to the plane of a layer}	2202/03	. Treatment under cryogenic or supercritical conditions
12/224	. . {for motion along a direction within the plane of a layer}	2202/05	. Use of magnetic field
12/226	. . {for rotary motion}	2202/06	. Use of electric fields
12/30	. Platforms or substrates	2202/07	. by induction
12/33	. . translatory in the deposition plane	2202/09	. Use of non-gravitational conditions
12/37	. . Rotatable	2202/11	. Use of irradiation
12/38	. {Housings, e.g. machine housings}	2202/13	. Use of plasma
12/40	. Radiation means	2202/15	. Use of fluidised beds
12/41	. . characterised by the type, e.g. laser or electron beam	2202/17	. use of centrifugal or vortex forces
12/42	. . . Light-emitting diodes [LED]	2203/00	Controlling
12/43	. . . pulsed; frequency modulated	2203/01	. To-be-deleted with administrative transfer to B22F 2203/00
12/44	. . characterised by the configuration of the radiation means	2203/03	. for feed-back
12/45	. . . Two or more	2203/05	. thermal expansion
12/46	. . with translatory movement	2203/11	. temperature, temperature profile
12/47	. . . parallel to the deposition plane	2203/13	. pressure
12/48	. . . in height, e.g. perpendicular to the deposition plane	2203/15	. weight
12/49	. . Scanners	2207/00	Aspects of the compositions, gradients
12/50	. Means for feeding of material, e.g. heads	2207/01	. Composition gradients
12/52	. . Hoppers	2207/03	. . of the metallic binder phase in cermets
12/53	. . Nozzles	2207/05	. . . eta-phase
12/55	. . Two or more means for feeding material	2207/07	. . Particles with core-rim gradient
12/57	. . Metering means	2207/11	. Gradients other than composition gradients, e.g. size gradients
12/58	. . for changing the material composition, e.g. by mixing	2207/13	. . Size gradients
12/60	. Planarisation devices; Compression devices	2207/15	. . Temperature gradients
12/63	. . Rollers	2207/17	. . density or porosity gradients
12/67	. . Blades	2207/20	. Cooperating components
12/70	. Gas flow means	2301/00	Metallic composition of the powder or its coating
12/80	. Plants, production lines or modules	2301/05	. Light metals
12/82	. . Combination of additive manufacturing apparatus or devices with other processing apparatus or devices	2301/052	. . Aluminium
12/84	. . . Parallel processing within single device	2301/054	. . Alkali metals, i.e. Li, Na, K, Rb, Cs, Fr
12/86	. . . Serial processing with multiple devices grouped	2301/056	. . Alkaline metals, i.e. Ca, Sr, Ba, Ra
12/88	. . Handling of additively manufactured products, e.g. by robots	2301/058	. . Magnesium
12/90	. Means for process control, e.g. cameras or sensors	2301/10	. Copper
2201/00	Treatment under specific atmosphere	2301/15	. Nickel or cobalt
2201/01	. Reducing atmosphere	2301/155	. . Rare Earth - Co or -Ni intermetallic alloys
2201/013	. . Hydrogen	2301/20	. Refractory metals
2201/016	. . NH ₃	2301/205	. . Titanium, zirconium or hafnium
2201/02	. Nitrogen	2301/25	. Noble metals, i.e. Ag Au, Ir, Os, Pd, Pt, Rh, Ru
2201/03	. Oxygen	2301/255	. . Silver or gold
2201/04	. CO or CO ₂	2301/30	. Low melting point metals, i.e. Zn, Pb, Sn, Cd, In, Ga
2201/05	. Water or water vapour	2301/35	. Iron
2201/10	. Inert gases	2301/355	. . Rare Earth - Fe intermetallic alloys
2201/11	. . Argon	2301/40	. Intermetallics other than rare earth-Co or -Ni or -Fe intermetallic alloys
2201/12	. . Helium	2301/45	. Rare earth metals, i.e. Sc, Y, Lanthanides (57-71)
2201/20	. Use of vacuum	2302/00	Metal Compound, non-Metallic compound or non-metal composition of the powder or its coating
2201/30	. Carburising atmosphere	2302/05	. Boride
2201/32	. Decarburising atmosphere	2302/10	. Carbide
		2302/105	. . Silicium carbide (SiC)
		2302/15	. Carbonitride

- 2302/20 . Nitride
- 2302/205 . Cubic boron nitride
- 2302/25 . Oxide
- 2302/253 . . Aluminum oxide (Al₂O₃)
- 2302/256 . . Silicium oxide (SiO₂)
- 2302/30 . Oxynitride
- 2302/35 . Complex boride, carbide, carbonitride, nitride, oxide or oxynitride
- 2302/40 . Carbon, graphite
- 2302/403 . . Carbon nanotube
- 2302/406 . . Diamond
- 2302/45 . Others, including non-metals

2303/00 Functional details of metal or compound in the powder or product,

- 2303/01 . Main component
- 2303/05 . Compulsory alloy component
- 2303/10 . Optional alloy component
- 2303/15 . Intermetallic
- 2303/20 . Coating by means of particles
- 2303/25 . Coating by means of fibres
- 2303/30 . Coating alloy
- 2303/35 . Molten metal infiltrating a metal preform
- 2303/40 . Layer in a composite stack of layers, workpiece or article
- 2303/405 . . Support layer
- 2303/45 . Part of a final mixture to be processed further

2304/00 Physical aspects of the powder

- 2304/05 . Submicron size particles
- 2304/052 . . Particle size below 1nm
- 2304/054 . . Particle size between 1 and 100 nm
- 2304/056 . . Particle size above 100 nm up to 300 nm
- 2304/058 . . Particle size above 300 nm up to 1 micrometer
- 2304/10 . Micron size particles, i.e. above 1 micrometer up to 500 micrometer
- 2304/15 . Millimeter size particles, i.e. above 500 micrometer

2998/00 Supplementary information concerning processes or compositions relating to powder metallurgy

NOTE

In this group, C-Sets are used. Detailed information about C-Sets construction and the associated syntax rules is found in the Definitions.

- 2998/10 . Processes characterised by the sequence of their steps

NOTE

In this group, C-Sets are used. Detailed information about C-Sets construction and the associated syntax rules is found in the Definitions.

2999/00 Aspects linked to processes or compositions used in powder metallurgy

NOTE

In this group, C-Sets are used. Detailed information about C-Sets construction and the associated syntax rules is found in the Definitions.