PRODUCT CATALOGUE

SINTERMETALI Ltd

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I.The Method Of Powder Metallurgy

1. Description of the Powder Metallurgy method.

Powder Metallurgy is the process where by metal parts in large quantities can be made by compressing and sintering various powdered metals such as brass, bronze, stainless steel, and iron. Compressing of the metal powder into the part to be made is done using accurately formed dies and punches in special types of hydraulic or mechanical presses. The "green" compressed pieces are then sintered in an atmosphere-controlled furnace at high temperatures, causing the metal powder particles to be bonded together metallurgically. A subsequent sizing or coining operation and supplementary heat treatments may be employed. The physical properties of the final product are comparable to those of cast or wrought products of the same composition, if the parts are processed to provide high density.

Advantages of Powder Metallurgy Parts requiring irregular curves, eccentrics, radial projections, or recesses often can be produced only by powder metallurgy. Parts that require irregular holes, key-ways, flat sides, splines or square holes that are not easily machined, can usually be made by this process. Tapers and counter bores are easily produced. Axial projections can be formed but the permissible size depends on if the powder will flow into the die recesses. Slots, grooves, blind holes, and recesses of varied depths are also obtainable. In summary, the process provides close dimensional tolerances, minimal machining, good surface finish, and excellent part-to-part reproducibility for moderate to high volume part production.

Limiting Factors in the Powder Metal Process Features should be avoided that result in tooling with thin sections or sharp inside corners. Multiple axial projections result in complex tooling and there are limitations on the number which can be formed. Undercuts, cross-holes and re-entrant angles cannot be molded and therefore must be machined after sintering.

2. Advantages of the Powder Metallurgy method.

- Eliminates or minimizes machining
- Eliminates or minimizes scrap losses
- Maintains close dimensional tolerances
- Achieves a wide variety of alloy systems
- Produces good surface finishes
- Provides materials which may be heat-treated for increased strength or enhanced wear resistance
- Provides controlled porosity for self-lubrication or filtration.

- Facilitates manufacture of complex or unique shapes which would be impractical or impossible with other metalworking processes
- Suited to moderate-to-high volume component productions requirements
- Offers long-term performance reliability in critical applications
- Outstanding Cost Effectiveness

Powdered metal has virtually no waste so material costs are dramatically lowered. In addition, PM's unique ability to produce parts with close dimensional tolerances eliminates or minimizes the need for secondary operations, cutting out a potentially costly and time-consuming step in the manufacture process.

- Unparalleled Flexibility

The PM process can produce parts that are tailor made to each and every need, including components in complex or unique shapes that would be prohibitively costly to achieve with other metalworking processes. PM can be heat treated to provide additional strength, and PM components provide controlled porosity for self-lubrication.

II.Structural PM Parts

The structural PM parts manufactured through the method of Powder Metallurgy (gear wheels, pawls, disks, rings, sleeves, etc.) are widely used in engineering and other branches of industry.

Figure 1: Selection of structural PM parts manufactured by Sintermetali

1. Size limitations for the structural PM parts.

Cross section area	< 80 mm^2
Maximum overall dimension	< 180 mm
Height	From 3 to 50 mm

2. Types of structural PM parts according to their technological characteristics and chemical composition.

2.1 Structural PM parts of low density: 6.4 to 6.9 x 10^3 kg/m^3.

Basic properties:

Tensile strength	From 150 to 350 MPa
Relative elongation	From 0.5 to 6%
Brinell hardness	From 300 to 1000 MPa

Material options: sintered steel alloyed with copper, sintered steel alloyed with carbon and copper, sintered steel alloyed with chromium, sintered steel alloyed with chromium and nickel, sintered steel alloyed with phosphorus, sintered steel alloyed with copper and nickel, sintered steel alloyed with nickel, sintered bronze, sintered bronze graphite.

2.2 Structural PM parts of medium density: 6.9 to 7.2 x 10^3 kg/m^3.

Basic properties:

Tensile strength	From 180 to 600 MPa
Relative elongation	From 1.3 to 20%
Brinell hardness	From 450 to 1100 MPa

Material options: sintered steel alloyed with copper, sintered steel alloyed with chromium, sintered steel alloyed with chromium and nickel, sintered steel alloyed with copper and nickel, sintered steel alloyed with nickel, sintered bronze.

2.3 Structural PM parts of high density: more than 7.2 x 10^3 kg/m^3.

Basic properties:

Tensile strength	From 400 to 600 MPa
Relative elongation	From 1 to 15%
Brinell hardness	From 700 to 1600 MPa

Material options: iron impregnated with copper, iron-graphite impregnated with copper, steel impregnated with copper, iron-graphite impregnated with brass.

2.4 Structural PM parts of steel alloyed with chromium and nickel. Structural PM parts of stainless steel.

Basic properties:

Density	From 6.3 to 7.4 x 10^3 kg/m^3
Tensile strength	From 230 to 500 MPa
Relative elongation	From 3 to 15%
Brinell hardness	From 700 to 1300 MPa

Material options: steel alloyed with chromium in the range from 13 to 20% and nickel up to 14%.

2.5 Hydraulically dense parts (very typical application is attachment flanges in the engineering of food processing machines).

Basic properties:

Density	> 7.4 x 10^3 kg/m^3
Tensile strength	> 500 MPa
Relative elongation	From 3 to 15%
Brinell hardness	From 900 to 1400 MPa

Material options: steel alloyed with chromium in the range from 13 to 20%, nickel up to 14% and molybdenum up to 3%.

2.6 Structural brass parts.

Basic properties:

Density	From 7.1 to 7.7 x 10^3 kg/m^3
Tensile strength	From 110 to 240 MPa
Relative elongation	From 11 to 18%
Brinell hardness	From 300 to 500 MPa

Material options: sintered brass, sintered high-density brass.

2.7 Structural copper parts.

Basic properties:

Density	From 8.0 to 8.4 x 10^3 kg/m^3
Tensile strength	From 180 to 220 MPa
Brinell hardness	From 400 to 500 MPa
Electric resistance	From 0.032 to 0.045 x 106 ohm.m

Material options: sintered iron-nickel, iron-nickel-cobalt.

2.8 Structural PM parts with a pre-set coefficient of thermal expansion.

Basic properties:

Density	From 7.3 to 7.5 x 10^3 kg/m^3
Tensile strength	From 380 to 400 MPa
Relative elongation	From 12 to 13%

Material options: sintered iron-nickel, iron-nickel-cobalt.

3. Several typical applications of the Structural PM parts:

- In engines: oil pump gear wheels, valve guides, toothed brushes, and synchronizers.
- In agricultural engineering: metering wheels, arresters, rolls, and spacer bushes.
- In hydraulics: distributing plates, supporting plates, spacer bushes, sockets.
- In electrical engineering: stator bushes, brush holders, gearwheels, and eccentrics.
- In automobile industry: shock absorber parts.

III.Antifriction PM parts

The antifriction PM parts are used mainly as self-lubricating sliding bearings. The availability of certain amount of graphite and open pores filled with mineral oil in the structure of the parts increase the wear resistance and the loading capacity. This feature of the antifriction PM parts accounts for their very low friction coefficient.

Figure 2 Selection of antifriction PM parts manufactured by Sintermetali

The advantages of the antifriction PM parts are minimized consumption of lubricants, quiet operation, and possibility for low and high-speed operation.

1. Types of antifriction PM parts according to their form.

1.1 Cylindrical bearing bushes.

Outer diameter	4 to 180 mm	Accuracy IT 8
Internal diameter	2 to 170 mm	Accuracy IT 7
Length	3 to 50 mm	Accuracy +/- 0.5 IT 11

1.2 Flanged bearing bushes.

Outer flange diameter	5 to 180 mm	Accuracy IT 8
Outer bush diameter	4 to 180 mm	Accuracy IT 8
Internal diameter	2 to 170 mm	Accuracy IT 7
Flange thickness	1.5 to 45 mm	Accuracy +/- 0.5 IT 11
Length	3 to 50 mm	Accuracy +/- 0.5 IT 11

1.3 Spherical bearing bushes.

Sphere diameter	8 to 22 mm	Accuracy IT 9
Outer diameter	7.7 to 21 mm	
Internal diameter	3 to 12 mm	Accuracy IT 7
Length of cyl. section	2 to 7 mm	

Length	6 to 15 mm	Accuracy +/- 0.5 IT 11

2. Types of antifriction PM parts according to their composition.

2.1 Antifriction PM parts on iron base.

Basic properties:

Density	From 5.8 to 6.5 x 10^3 kg/m^3
Porosity	> 18%
Radial compression strength	From 170 to 450 MPa

Material options: sintered iron alloyed with copper, sintered iron alloyed with copper and carbon, sintered iron alloyed with chromium, sintered iron alloyed with phosphorus and graphite.

2.2 Antifriction PM parts on copper base.

Basic properties:

Density	From 6.2 to 7.0 x 10^3 kg/m^3
Porosity	> 18%
Radial compression strength	From 120 to 230 MPa

Material options: sintered bronze, sintered bronze-graphite, sintered bronze-iron-graphite.

3. Several typical applications of the antifriction PM parts:

- In the automobile industry (bearings for starters and generators)
- Agricultural engineering
- Office appliances (copy machines, microprocessor fans)
- Electrical engineering (household appliances)

IV.Soft Magnetic PM parts

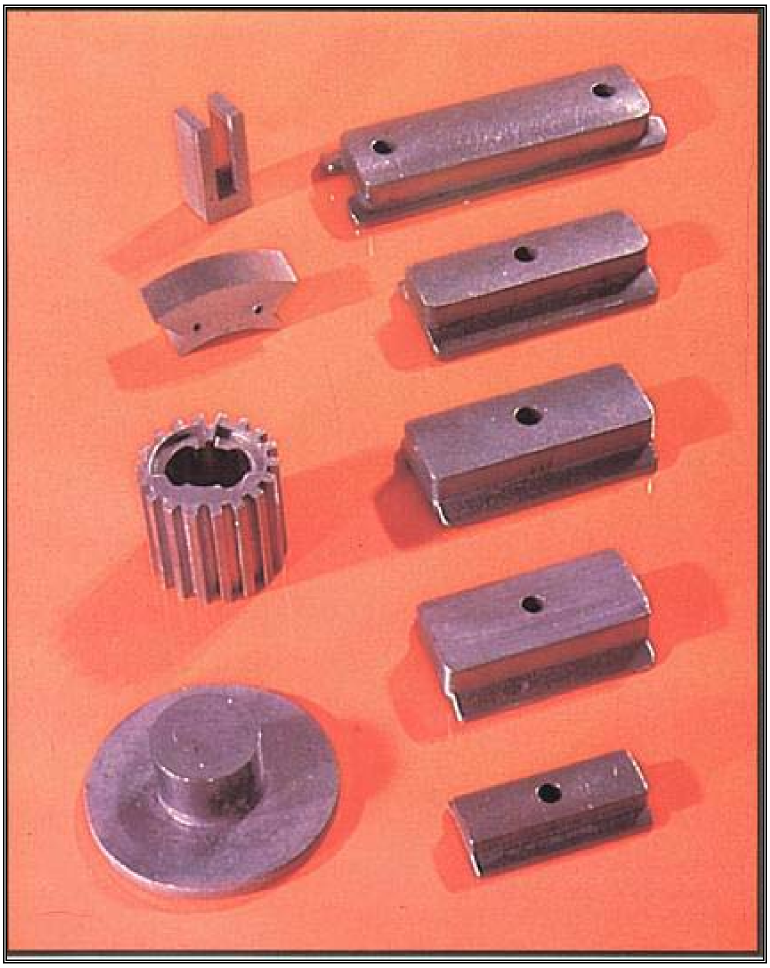

Figure 3 Selection of soft magnetic PM parts manufactured by Sintermetali

1. General data about the soft magnetic PM parts.

Basic properties:

Density	From 6.4 to 7.4 x 10^3 kg/m^3
Tensile strength	From 150 to 350 MPa
Relative elongation	From 8 to 12%
Brinell hardness	From 500 to 1200 Mpa

Material options: iron-based powders with carbon content less than 0.1% and phosphorus from 0.015 to 0.6%.

2. Magnetic characteristics.

Magnetic permeability	From 1.6 to 2.6 x 10^{-2}
Magnetic induction	From 1.0 to 1.35 T
Co-ercitive force	From 120 to 180 A/m

3. Several typical applications of the soft magnetic PM parts:

- Pole pieces for electric motors and electric measuring instruments
- Housings for small electric motors

V.High Porous PM Parts

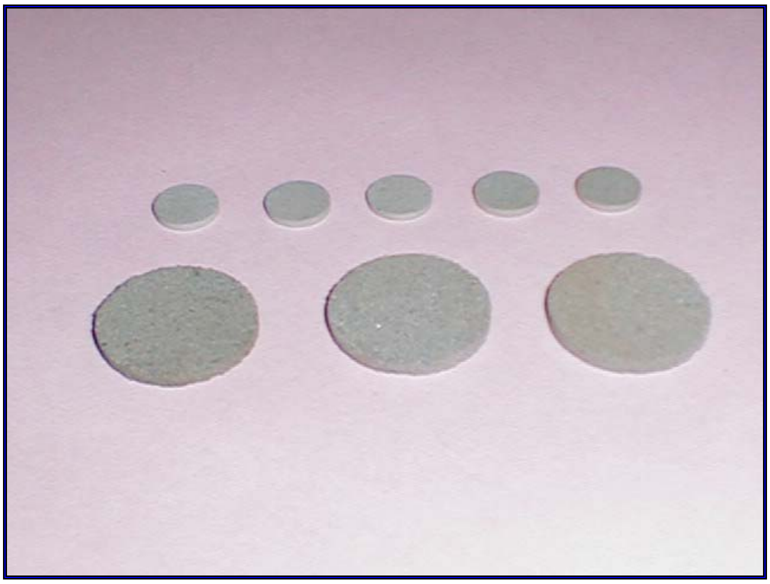

Figure 4 Selection of high porous PM parts manufactured by Sintermetali

1. General data about the high porous PM Parts.

Basic properties:

Tensile strength	From 15 to 120 MPa
Porosity	From 25 to 52%
Transmission factor	From 0.2 to 90 x 10^{-12} m^2
Filtration degree	From 3 to 100 μm
Maximum operation t°	< 450° C

Material options: chromium-nickel powders, chromium-nickel-molybdenum stainless steel.

2. Several typical applications of the high porous PM parts:

- Filters for liquids and gases
- Noise silencers in the pneumatics
- Fire barriers in gas burners and electric machines
- Porous electrodes and diaphragms
- Catalyst carriers in chemical industry