The P/M Process:
How P/M Parts Are Made

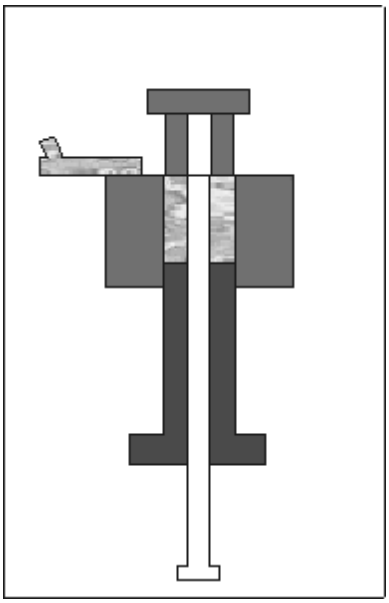
There are three basic steps for producing conventional density parts by the powdered metallurgy process: Mixing, Compacting, Sintering.

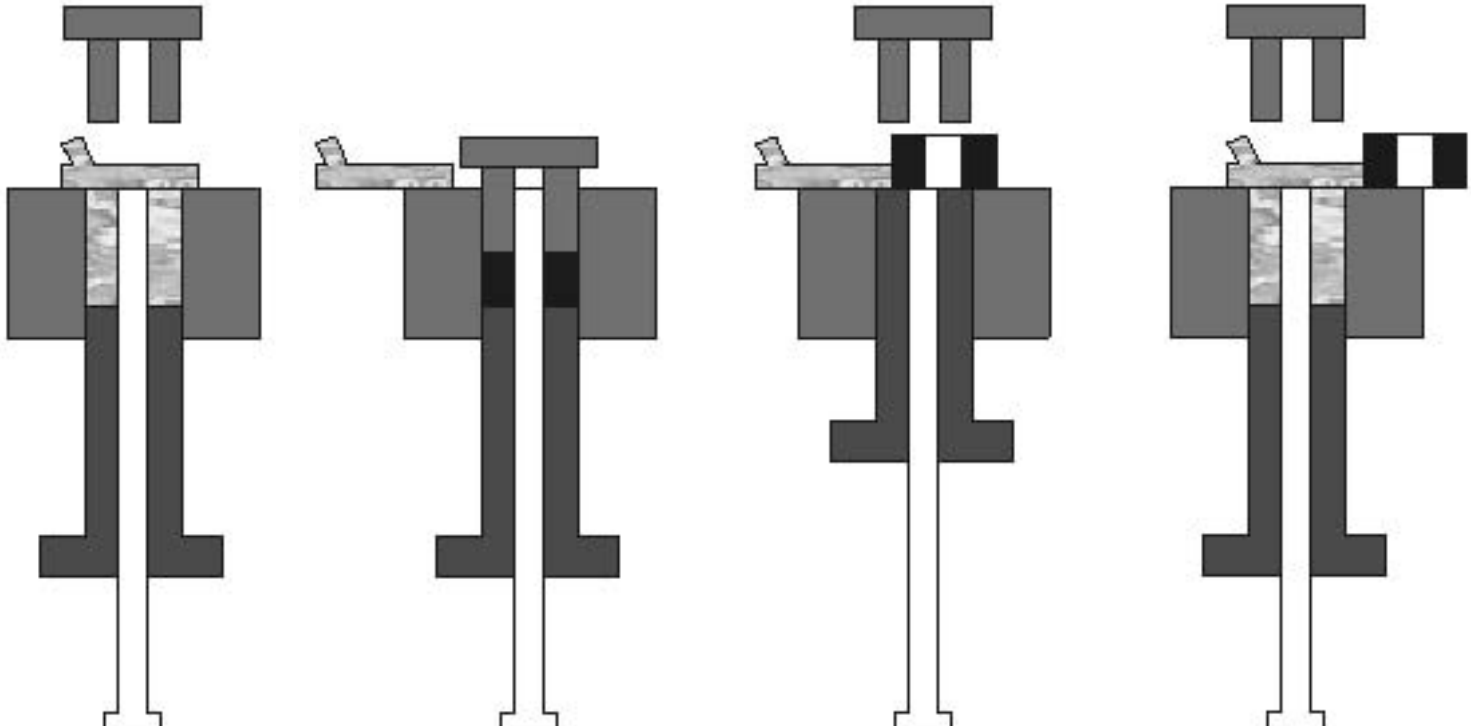
STEP ONE: MIXING

Elemental or pre-alloyed metal powders are first mixed with lubricants or other alloy additions to produce a homogeneous mixture of ingredients. The initial mixing may be done by either the metal powder producer or the P/M parts manufacturer.

STEP TWO: COMPACTING

A controlled amount of mixed powder is automatically gravity-fed into a precision die and is compacted at pressures usually between 30 and 50 tons per square inch depending on the density requirements of the part. Compacting the loose powder produces a "green compact", which in conventional pressing techniques, has the size and shape of the finished part when ejected from the die, and sufficient strength for in-process handling and transport to a sintering furnace. Typical compacting uses rigid dies set into special mechanical or hydraulic presses.
Tool sets are made of either hardened steel and/or carbides, and consist of at least a die body or mold, and upper and lower punch, and in some cases one or more core rods.





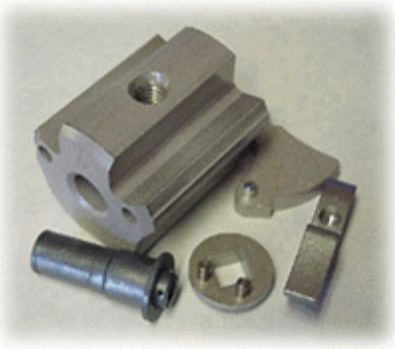
STEP THREE: SINTERING

In the typical sintering step, the "green compact", placed on a wide-mesh belt, slowly moves through a controlled-atmosphere furnace. Parts are heated to below the melting point of the base metal, held at the sintering temperature, and then cooled. Basically a solid state process, sintering is transforms compacted mechanical bonds between the powder particles into metallurgical bonds. This process provides the P/M part's primary functional properties. P/M parts generally are
ready for use after sintering. However, some secondary processes may be necessary to finish the part and bring it to within the customer's specifications.

SECONDARY OPERATIONS

P/M parts maybe repressed, impregnated, machined, tumbled, plated, or heat treated following sintering is special properties are required.

- **Repressing** - coining or sizing, effects the densification and dimensional control.



- **Oil Impregnation** makes bearings self-lubricating.
- **Resin Impregnation** may be used to improve machinability., seal parts gas or liquid tight, or prepare the surface for plating.
- **Ferrous Infiltration** improves strength and seals parts gas or liquid tight.
- **Structural Infiltration** prepares the surface for plating with other metals and improves the ductility and machinability.
- **Heat Treating** improves the strength and hardness and makes the surface hard and wear resistant.
- **Machining** can be done to install set or assembly screws, form undercuts or slots, or to remove stock to make faces parallel and improve surface finishes.

- **Finishing** includes, deburring, burnishing, coating oil dip, plating, welding, and mechanical surface treatments