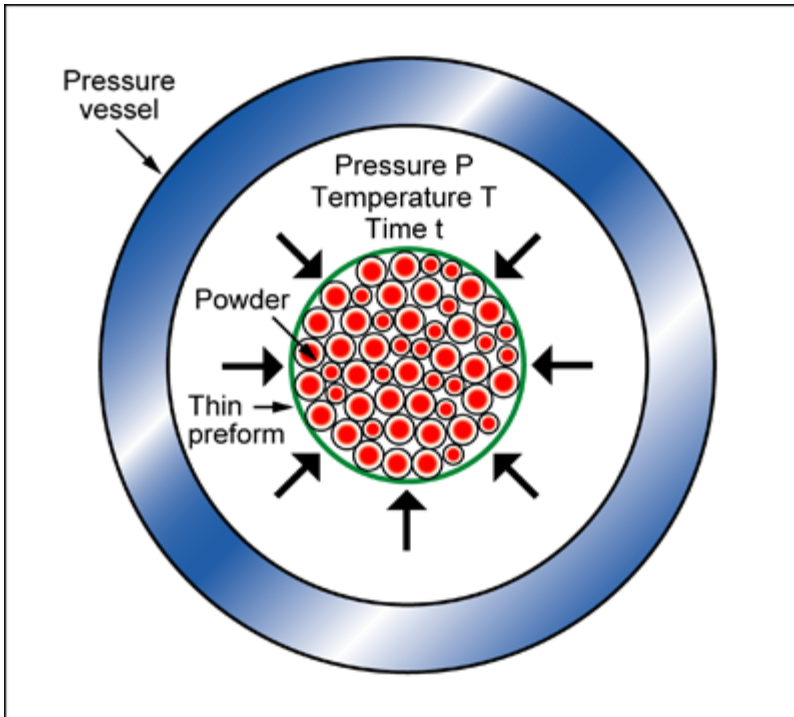


## Description

### Process schematic



### Figure caption

Hot isostatic pressing

### The process

In HOT ISOSTATIC PRESSING a powder is sealed in a deformable metal container (the 'can') and then subjected to a high temperature at high pressure (1100C, 200MPa) in a pressure vessel, inside which there is a furnace surrounding the container in which the powder is loaded. Argon is used as the pressurizing medium. In the 'SINTER-HIP' process, a variation of HIPing, the initial sintering of the compacts and their subsequent densification are done sequentially in the same vessel. The main advantage of HIPing is its ability to produce components which are 100% dense and having uniform isotropic properties, but it is expensive, limiting its use to those applications in which the integrity of the material is of prime importance (e.g. turbine disks and blades).

### Tradenames

HIP; CAP process; CERACON

## Material compatibility

Ceramics	✓
Metals - ferrous	✓
Metals - non-ferrous	✓

## Shape

Solid 3-D	✓
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## Economic compatibility

Relative tooling cost	low
Relative equipment cost	very high

Labor intensity	high		
Economic batch size (units)	1	-	1e4

### Physical and quality attributes

Mass range	0.1	-	300	kg
Range of section thickness	5	-	500	mm
Tolerance	0.5	-	1	mm
Roughness	2	-	6.3	μm
Surface roughness (A=v. smooth)	B			

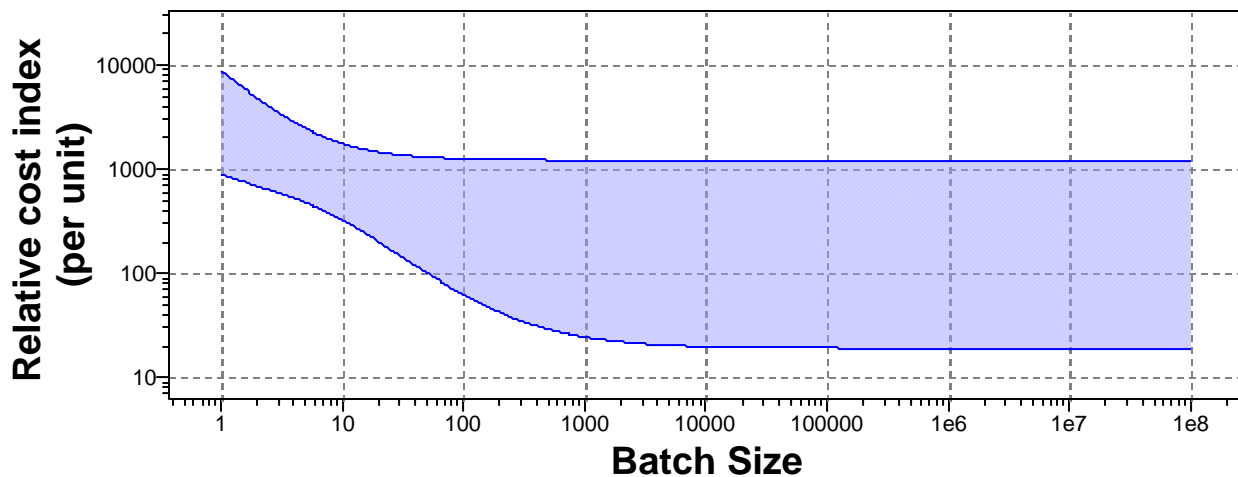
### Process characteristics

Primary shaping processes	✓
Discrete	✓

### Cost model and defaults

Relative cost index (per unit)	24.6	-	1.22e3
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Parameters: Material Cost = 8USD/kg, Component Mass = 1kg, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Material Cost=8USD/kg, Component Mass=1kg, Overhead Rate=150USD/hr, Capital Write-off Time=5yrs, Load Factor=0.5, Discount Rate=5%

Capital cost	3.28e5	-	3.28e6	USD
Material utilization fraction	0.8	-	0.9	
Production rate (units)	0.2	-	50	/hr
Tooling cost	328	-	8.2e3	USD
Tool life (units)	300	-	3e3	

### Supporting information

#### Design guidelines

HiPing has some shape limitations - sidewalls must be parallel; undercuts and screw threads are not possible. Cylindrical billets are the most cost effective product form.

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**Technical notes**

Most metals and ceramics can be consolidated by HIPing.

**Typical uses**

Production of tool steel and tungsten carbide cutting tools such as hobs and shaper cutters. Making superalloy components such as superalloy blades for high temperature gas turbines for the aerospace industry.

**The economics**

Capital costs are high (but lower than conventional injection molding), but tooling costs are low due to the low injection pressures. Energy consumption is also lower than conventional injection molding. The cycle time is largely controlled by cure time and open mold time (part ejection maybe difficult with thermosets).

**The environment**

Fine powders can be pyrophoric and carcinogenic.

**Links**

[MaterialUniverse](#)

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