

PNEUMATIC ISOSTATIC FORGING

AN ADVANCED DENSIFICATION TECHNOLOGY

TECHNICAL DATASHEET



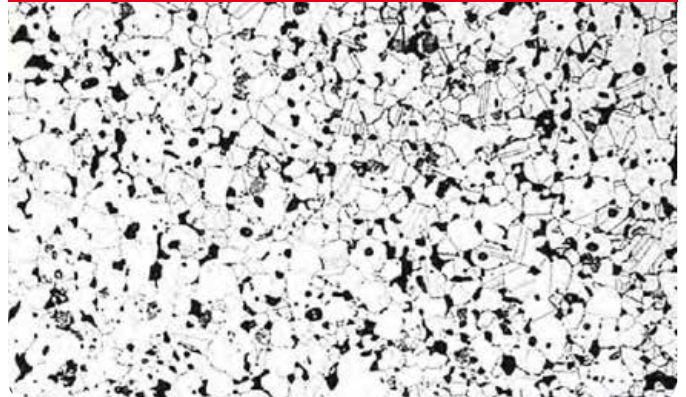
DESCRIPTION

AMETEK Specialty Metal Products offers an advanced densification technology combining high pressure forging with a moderate temperature range. This patent pending process provides high density and controlled microstructure for high performance products made from metal, ceramic, or composite powders. This process is known as pneumatic isostatic forging (PIF) and extends our wrought powder metallurgical manufacturing technology to heavy gauge materials like rod, plate, and tubing.

The addition of pressure to sintered materials has been available for several years through processes such as low pressure assisted sintering, hot isostatic pressing, and hot forging techniques. All of these pressure assisted processing techniques have had limited success except for very expensive materials or special component applications due to either cost, performance characteristics, and/or limited quantity throughput. PIF provides a solution to these limitations.



**SAMPLE MATERIAL AT
88% DENSE POST- PIF (100X)**



**SAMPLE MATERIAL AT
100% DENSE POST- PIF (100X)**



ADVANTAGES

Our pneumatic isostatic forging (PIF) process extends wrought metal powder fabrication technology, which is used to manufacture light and heavy gauge strip products, to include heavy gauge or thick section stock by:

- Producing high density in powder metal compacts while preserving or enhancing mechanical and magnetic properties.
- Providing a near net shape manufacturing technology.
- Offering a controlled microstructure by trading off temperature against pressure to produce high density.
- Providing a rapid processing technique for producing high density materials.

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THE PNEUMATIC ISOSTATIC FORGING (PIF) PROCESS

PIF is used to provide high performance metal powder components by significantly increasing density and providing controlled microstructural properties (see photos on front). A true forging process uses high stress and plastic deformation.

PIF uses a high pressure gas to close the porosity, thereby increasing density while maintaining or improving the microstructure of the material. PIF is a process akin to high tech blacksmithing, i.e., it uses a gas hammer to forge the material to density.

CUSTOM MECHANICAL PROPERTIES

Typical of a forging process, PIF uses temperature, pressure, and time to effect consolidation of the material. Subsequently, an appropriate depressurization and cooling cycle is deployed to obtain specific material properties. PIF is well suited to automation, enabling rapid throughput with a pressure cycle of less than two minutes. The material is processed as sequential batches which are sized to obtain specific quantities or pounds of throughput per hour.



HIGH PERFORMANCE ALLOYS

PIF has been applied successfully to a range of materials including, iron, stainless steel, copper, aluminum, nickel, chromium, titanium, tungsten, rhenium, molybdenum, as well as various composites and ceramics. PIF has been utilized on preforms that are cast, die compacted, cold isostatically pressed, or metal injection molding with each resulting in higher performance properties than those achieved by other densification technologies. For many materials, powders are directly processed via PIF to full density by encapsulation in containers of simple geometric forms. Fabrications by the PIF process result in a compact which is superior to conventional methods.



MISSION-CRITICAL APPLICATIONS

PIF represents an ongoing effort by AMETEK Specialty Metal Products to offer its customers the highest quality products made from high purity materials. The process extends our existing range of technologies for producing fully dense metal powder components in a variety of shapes and sizes.

The process is used to manufacture products for demanding applications in markets that include oil field tools, electronics industry, automotive components, vacuum deposition sputtering targets, and medical products.

WALLINGFORD / **AMETEK**
SPECIALTY METAL PRODUCTS

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