



NEWS

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The winners in the 2023 Powder Metallurgy (PM) Design Excellence Awards competition, sponsored by the Metal Powder Industries Federation (MPIF), demonstrate outstanding examples of PM's diversity and ability to meet critical requirements. From electric vehicles to medical implants, once again, parts fabricators have demonstrated PM's versatility and unique ability to challenge competing technologies. These award-winning components use PM's flexibility to push forward new concepts and process controls to demonstrate the inexhaustible range of PM's capabilities.

Ten Grand Prizes and fifteen Awards of Distinction were given in this year's competition, segmented into 3 categories: Conventional Press and Sinter PM; Metal Injection Molding (MIM); and Metal Additive Manufacturing (AM).

GRAND PRIZE AWARDS

A Grand Prize in the Automotive—Engine Category for Conventional PM components has been awarded to **APG Sintered Metals, a Division of Nichols Portland Inc.**, for a 20-degree slanted oxygen sensor boss used on catalytic converters for V6 trucks. This SS-409L stainless steel sensor boss is produced by compacting to near-net-shape, de-lubricating in a low-temperature belt furnace, and sintering in a high-temperature pusher furnace in a hydrogen atmosphere. Sensor bosses are integral structural components of the increasingly complex automotive exhaust and emissions after-treatment systems. They are designed to be welded in place permanently, while allowing quick assembly line installation and long-term serviceability of a growing number of critical exhaust gas sensors. The failure of any one of these sensors or mounts can cause a noticeable drop in engine performance and can result in damage to expensive emissions control hardware.

A Grand Prize in the Automotive—Electric Vehicle Category for Conventional PM components has been awarded to **Burgess-Norton Mfg. Co.**, and their customer **Means Industries**, for a notch plate and pocket plate used in an electro-mechanical E-axle disconnect. The parts are made from FLNC-4408 sinter-hardened steel to a density of 7.1 g/cm³. Both parts rotate in the assembly and have balance requirements that are maintained through a combination of tooling geometry, die-fill compensation, and sectional densities, to avoid the need for a balance correction operation. The main benefit of this electric actuated dynamic disconnect clutch system is the increased vehicle efficiency; improving overall vehicle range by 10% because of the ability to disconnect the rear wheels from the electric motors. PM provides a 9% weight saving, which also improves battery life.

A Grand Prize in the Automotive—Transmission Category for Conventional PM components has been awarded to **GKN Sinter Metals** and their customer **Ford Motor Company**, for a differential gear set locking ring used in a rear axle electronic locking differential. This combination of parts (pinion gears, side-gears {locking and non-locking}, and lock plate) are compacted, carburized, net-shape powder forged, quench-hardened and tempered, and machined to tight dimensional and surface finish requirements. The total set weighs just over 5.4 kg (12 lb). The parts passed full validation for all Ford F-250/350 truck application tests including full axle dyno, fatigue (locked and unlocked), impact, differential seizure, spline interface, and full vehicle durability. This is the 5th production tooled differential gear set to date.

A Grand Prize has been awarded to **INDO-MIM Pvt Ltd.**, in the Hand Tools/Recreation Category for MIM components for a MIM-17-4 PH stainless steel keeper release used in a subassembly for safety door locks. This 60-mm (2.4 inch) long part has a square central cross-section with rectangular blocks at each end. There is also an “h” shaped projection part way along the central section. The part is molded in a multi-cavity tool in which a side core covers the “h” profile and another side core from one end covers the hole profile. The part is used in safety door locks and needs to handle the frictional forces and wear and tear involved.

In the Electronic/Electrical Components Category for MIM components, a Grand Prize has been awarded to **Hangzhou Sino-MIM Technology Co. Ltd.**, for a heatsink used in an optical communication 5G base station photoelectric module bracket for heat dissipation. The part is made from a tungsten-copper (W-Cu 80/20) duplex pseudo alloy. The feed material is a nano-grade metal powder, so the mold requirements are very high. The design has one mold with two cavities. The product was made previously using copper infiltrated tungsten processed using CNC and wire EDM, a complex and expensive process. MIM processing reduced the cost by more than 45% and the production cycle time was shortened.

A Grand Prize has been awarded to **Hangzhou Sino-MIM Technology Co. Ltd.**, in the Hardware/Appliances Category for MIM components for a screw used in a juice maker. The part was originally designed as a plastic injection molded component that was easily deformed and had poor wear resistance. MIM-304L stainless steel was suggested as an alternative. However, the metallic part weighed nearly 860 g which was not ideal. The component was therefore divided into several small parts and a structure created with a hollow interior which reduced the part mass to 470 g, a 45% reduction. The conversion from plastic to a MIM part has led to a better surface finish and mechanical properties, and a significant improvement in the lifetime of the product.

A Grand Prize in the Industrial Motors/Controls & Hydraulics Category for Metal AM components has been awarded to **Azoth**, for a fluid matter exchanger. While relatively simple in appearance on the outside, the part is extremely complex on the inside. The part is binder-jet processed using 316L stainless steel powder and the as-printed part is about 20% larger to account for shrinkage during sintering. The customer performs flowability as well as pressurized leak testing of the parts. The hollowness, internal channels, internal filters, and other complex features of this fluid matter exchanger make it a part only viable through additive manufacturing.

In the Medical/Dental Category for MIM components, a Grand Prize has been awarded to **Hangzhou Sino-MIM Technology Co. Ltd.**, for a titanium alloy kneecap bracket used to repair or replace a human kneecap. The part is made using a titanium alloy (Ti-6Al-4V) and weighs about 74 g. The surface of the parts is polished to a mirror finish. Traditional kneecaps are made from stainless steel which is too heavy and has lower surface wear resistance. They were made using CNC machining, had long lead times, and were very expensive. MIM reduced the cost by about 50%. The titanium alloy part has good biocompatible properties and is much lighter.

In the Medical/Dental Category for Metal AM components, a Grand Prize has been awarded to **3DEO Inc.** and their customer **USB Medical**, for a surgical implement articulation joint and pivot. The assembly is part of a surgical implement for performing laparoscopic heart surgery. The instrument is used to lift the heart gently, granting the surgeon access to the back of the heart. The three-part assembly is built from 17-4 PH stainless steel using 3DEO's layering process, in which 100 µm layers of powder are deposited, uniformly bonded edge-to-edge, and machined on a per-layer basis until the parts are fully built. Demand volume does not warrant MIM tooling investment, and metal AM retains the customer's ability to make future design changes.

In the Military/Firearms Category for MIM components, a Grand Prize has been awarded to **TriTech Titanium Parts LLC**, for a titanium ring clamp used in a mounting device for a rifle magnifying scope. The finished assembly includes two ring clamps attached to a cantilever mount, that is secured to the rifle with two quick disconnects. Each ring clamp is made of two parts, an inner ring, and an outer cage. The entire finished assembly is coated flat black with a thin-film protective ceramic coating by the customer. The titanium alloy (Ti-6Al-4V) ring clamp assembly replaces a heavier machined 6061 aluminum alloy version. To receive final approval, the assembly had to protect the scope after repeated drop testing. This titanium alloy part has four times the tensile and yield strength of the commonly used aluminum alloy.

AWARDS OF DISTINCTION

In the Automotive—Engine Category for Conventional PM components, an Award of Distinction has been given to **Metalpo Industria e Com Ltda** for a pressure flange made for their customer **MAN Truck and Bus Ag**. A design variation made from FD-0405 diffusion-alloyed steel was introduced, increasing the breaking load while reducing the mass and processing steps. The new design and process change also reduced greenhouse gas emissions.

In the Automotive—Engine Category for MIM components, an Award of Distinction has been given to **Hangzhou SINO-MIM Technology Co. Ltd.** for a turbocharger nozzle ring assembly. The product requires good strength, oxidation, and corrosion resistance at high temperatures. The parts had been made using a precision casting process that has lower production efficiency, poor dimensional accuracy, poor surface finish, and more secondary machining than MIM parts require. Only the MIM vane nozzle needs post process machining.

In the Automotive—Electric Vehicle Category for Conventional PM components, an Award of Distinction has been given to **Capstan Atlantic, an operating subsidiary of Capstan, Inc.**, and their customer **Nexteer Automotive** for a driven pulley made from FC-0208 copper steel and used in the power steering of an electric autonomous vehicle. It is bolted to the shaft controlling the steering of the car. The part is compacted with an integral top flange, and, after drilling, a stamped flange is welded onto the bottom of the part. Controlling distortion, tapering of the long, thin wall section, and maintaining the helix angle of the pulley teeth was crucial. A 2D bar code is laser marked on the parts for traceability as this is a safety-critical component.

In the Automotive—Transmission Category for Conventional PM components, an Award of Distinction has been given to **Burgess-Norton Mfg. Co.** for FL-4405HT prealloyed steel drive and driven sprockets used in a transfer case. The sprockets are used when the transfer case is engaged using a chain drive in pickup trucks with a hybrid drivetrain that incorporates battery propulsion and traditional internal combustion engine technology. Tooling concepts were developed and refined to extend tool life, for proper size management of the sprocket teeth and the two sets of involute splines. PM sprockets work well in high-density applications where part strength and resistance to wear is critical, and the near-net-shape capabilities of PM reduce costly machining steps and material scrap.

In the Automotive—Chassis Category for MIM components, an Award of Distinction has been given to **INDO-MIM Pvt Ltd.**, for right- and left-hand thread inserts made from MIM-4605 low-alloy steel (quenched & tempered) and used in collapsible roof systems to clamp and hinge different components of the system. The parts are made in a two-cavity hot runner mold. The optimum injection point is critical due to the varied sectional thicknesses and was determined via mold flow simulation. Thread auto unwinding was a major challenge for the tooling. Powder coating and electroplating enable the parts to satisfy a 2,000-hour salt spray test.

In the Lawn & Garden/Off-Highway Conventional PM components Category, an Award of Distinction has been given to **FMS Corporation** and their customer **Polaris Inc.**, for a clutch weight sub-assembly used in the primary clutch flyweight of an ATV continuously variable transmission. The flyweights are a speed-sensing component of the primary clutch in a CVT transmission. To accommodate the customer's request for a component that could be retrofitted into existing clutches, the design needed deep and complex face details to prevent interference with existing assembly geometry. The parts are made using a specially modified version of a chromium containing sinter-hardenable steel for high-performance applications.

In the Hand Tools/Recreation Category for Conventional PM components, an Award of Distinction has been given to **APG Sintered Metals, a Division of Nichols Portland Inc.**, for a 32T belt drive transmission sprocket used on several motorcycle platforms. The sprocket is made using FC-0208 copper steel to a 6.80 g/cm³ minimum density, and is steam treated to increase surface hardness and seal off surface porosity to reduce wear and corrosion. The re-designed PM part with lightening holes reduced the mass by 18%.

In the Hand Tools/Recreation Category for MIM PM components, an Award of Distinction has been given to **Indo-MIM Pvt Ltd.**, for a clamp body used in a sub-assembly for hand power tools. The part is U-shaped with a single boss on one leg, with three bosses and two pin-like projections on the opposite leg. An innovative and effective way of cooling and venting helped to prevent voids and weld lines. The MIM-4605 low-alloy steel part resulted in a cost saving of 60% compared with the machined part that it replaced.

In the Hardware/Appliances Category for Metal AM Components, an Award of Distinction has been given to **3DEO Inc.** and customer **Narita Manufacturing** for a fastener assembly for a bullet train. The fastener attaches the inter-car baffles to retaining frames on bullet trains. The 17-4 PH stainless steel metal AM assembly replaced ten individual components and four rivets, eliminating riveting, welding, and grinding from the production process. The parts must be able to be rotated with a tool but tamper resistant to passengers and resist unintended rotation due to train car motion and vibration.

In the Industrial Motors/Controls & Hydraulics Category for Conventional PM components, an Award of Distinction has been given to **Nichols Portland LLC, a Division of Nichols Portland Inc.**, for a gerotor assembly used in a diesel charge pump for a high-pressure diesel direct injection system applied in large construction and stationary power systems that need to operate for years in harsh environments. The part assembly consists of two single-level components possessing numerous critical tolerance features. The parts require exceptional material properties to minimize sliding and fretting wear in low-lubricity diesel fuel. The gerotor assembly also needs to provide a consistent delivery of diesel fuel across a range of operating conditions.

In the Industrial Motors/Controls & Hydraulics Category for MIM components, an Award of Distinction has been given to **MPP** and their customer **Schilling Robotics, a Technip FMC Company**, for a latch assembly used for the Seanet Cable Product. This 4-part (5-piece) assembly of MIM parts comprises latches and the latch tightening mechanism for a specialized electrical and communications cable used in the harsh environment of the deep ocean. Previously made from plastic, conversion to MIM-316L stainless steel was selected to resolve the problem of stretching and cracking. A low-friction, highly corrosion resistant coating is applied to the parts. A unique tooling approach reduced the customer's tooling cost by 75%.

In the Medical/Dental Category for Conventional PM components, an Award of Distinction has been given to **Metco Industries Inc.**, for a rail gear rack assembly used for the adjustment of hospital beds requiring higher weight limit capability. The final assembly consists of two identical PM parts that are rivetted to each end of a second PM part, the most complex part of the assembly. The copper-infiltrated (FX-1008-50) parts are zinc plated for product sterilizability.

In the Medical/Dental Category for MIM components, an Award of Distinction has been given to **Advanced Powder Products Inc.**, for lower anterior, upper central, bicuspid, and molar dental brackets. The brackets are part of a newly introduced and revolutionary orthodontic correction procedure. The four single-piece brackets are made using custom micro MIM-17-4 PH feedstock. The original complex two-piece design had many issues for MIM processing. The solution was found in a single-piece design in which the dovetail depth and position was modified.

In the Military/Firearms Category for MIM components, an Award of Distinction has been given to **ARC Group Worldwide**, for an S-7 tool steel locking block housed within the lower receiver of a semi-automatic pistol for securing and stabilizing movement of the slide and barrel. The locking block is a critical component of a 9-mm semi-automatic pistol and provides stability and support of the slide and barrel during actuation. The part is housed within a polymer frame that utilizes a single-action striker-fired trigger mechanism. MIM processing was selected for making this part because of the complexity, annual usage, and the existing presence in the firearms industry.

ARC Group Worldwide won a second Award of Distinction in the Military/Firearms Category for MIM components for a pistol slide stop. Prior to MIM processing this part was assembled from multiple pieces or machined. The MIM process provides a single, net-shape part that does not require any machining. The slide stop is used on a modern pistol to hold the slide open when the magazine is empty, or the user needs to open the action.

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Editor's Note: For further details or digital photos contact Dora Schember at MPIF dschember@mpif.org / 609-452-7700.

About the Metal Powder Industries Federation

Metal Powder Industries Federation is the North American trade association formed by the powder metallurgy industry to advance the interests of the metal powder producing and consuming industries and provides a single point of reference for all MPIF member companies.

MPIF 2023 Powder Metallurgy Design Excellence Award Winners



2023 Grand Prize Winners

Foreground: sensor boss, articulation joint & pivot, keeper release and heat sink

Middle Row: ring clamp, fluid matter exchanger, screw and kneecap bracket

Back Row: differential gear set locking ring & notch & pocket plate



2023 Award of Distinction Winners

Foreground: clutch weight assembly, pistol slide stop, dental brackets, clamp body, locking block, latch assembly and rail gear rack assembly

Middle Row: thread inserts, pressure flanges, fastener assembly, and gerotor assembly

Back Row: drive & driven sprockets, nozzle ring assembly, transmission sprocket and driven pulley

Digital Images Available Upon Request
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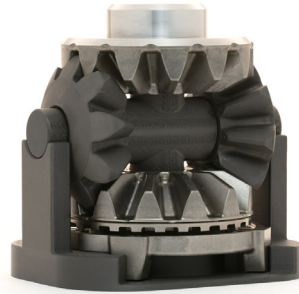
2023 MPIF Design Excellence Awards Grand Prize Winners



Automotive: Engine
Slanted Oxygen Sensor Boss
APG Sintered Metals
A Division of Nichols Portland Inc.



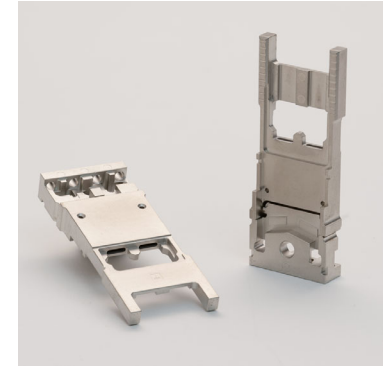
Automotive: Electric Vehicle
Notch Plate and Pocket Plate
Burgess-Norton Mfg. Co.



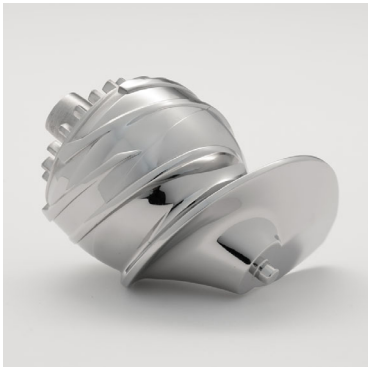
Automotive: Transmission
Gear Set Locking Ring
GKN Sinter Metals



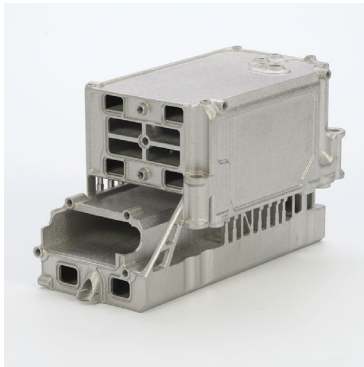
MIM Hand Tools/Recreation
Keeper Release
INDO-MIM Pvt Ltd.



MIM Electronic/Electrical
Heatsink
Hangzhou Sino-MIM Technology Co. Ltd.



MIM Hardware/Appliances
Screw
Hangzhou Sino-MIM Technology Co. Ltd



Metal Additive Manufactured
Industrial Motors/Controls/Hydraulics
Fluid Matter Exchanger
Azoth



MIM Medical/Dental
Kneecap Bracket
Hangzhou Sino-MIM Technology Co. Ltd



Metal Additive Manufactured
Medical/Dental
Articulation Joint and Pivot
3DEO

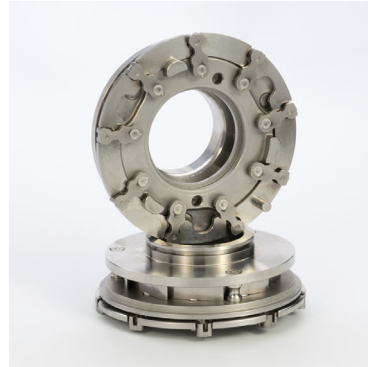


MIM Military/Firearms
Ring Clamp
TriTech Titanium Parts LLC

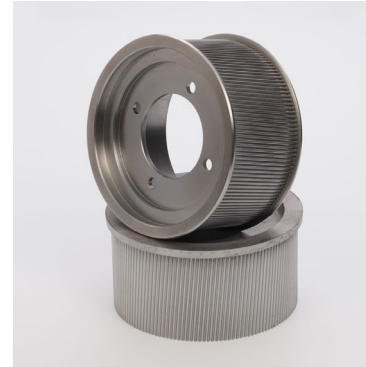
2023 MPIF Design Excellence Award of Distinction Winners



Automotive: Engine
Pressure Flange
Metalpo Industria e Commercio Ltda



MIM Automotive: Engine
Nozzle Ring Assembly
Hangzhou Sino-MIM
Technology Co. Ltd.



Automotive: Electric Vehicle
Driven Pulley
Capstan Atlantic



Automotive: Transmission
Drive & Driven Sprockets
Burgess-Norton Mfg. Co.



MIM Automotive: Chassis
Thread Inserts
INDO-MIM Pvt. Ltd.



Lawn & Garden/Off-Highway
Clutch Weight Assembly
FMS Corporation



Hand Tools/Recreation
Transmission Sprocket
APG Sintered Metals
A Division of Nichols Portland Inc.



MIM Hand Tools/Recreation
Clamp Body
INDO-MIM Pvt. Ltd.

2023 MPIF Design Excellence Award of Distinction Winners



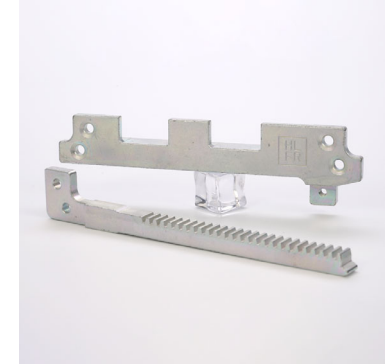
**Metal Additive Manufactured
Hardware/Appliance**
Fastener Assembly
3DEO Inc.



**Industrial Motors, Controls
& Hydraulics**
Gerotor Assembly
Nichols Portland LLC.
A Division of Nichols Portland Inc.



**MIM Industrial Motors, Controls
& Hydraulics**
Latch Assembly
MPP



Medical/Dental
Rail Gear Rack Assembly
Metco Industries, Inc.



MIM Medical/Dental
Dental Brackets
Advanced Powder Products, Inc.



MIM Military/Firearms
Locking Block
ARC Group Worldwide



MIM Military/Firearms
Pistol Slide Stop
ARC Group Worldwide