The rapid growth in MIM part production in recent years was reflected in the list of winning entries in this year’s MPIF PM Design Excellence Competition. A total of fourteen awards in eight application categories were announced at the Awards Luncheon on May 20 during the PM World Congress in Orlando, FL. MIM parts won three of the Grand Prize Awards and five of the Awards of Distinction. Altogether five of the awards went to overseas producers.

Grand Prizes
Indo-US MIM Tec Pvt. Ltd., Bangalore, India, was awarded the Grand Prize in the Automotive—Engine Category for four MIM parts that go into a device that controls fuel flow in Gasoline Direct Injection pumps, made for Stanadyne Corporation (Figure 1). Three of the parts are made of 440C stainless steel, while the fourth is made of 17-4 PH. The extremely complex geometry of one part, the blank discharge check, with the intercrossing of holes, required tooling with six side cores, three of which move at different timings. This design was believed by the fabricator to be perhaps the most complex, high-volume part ever made by MIM. The customer realised cost savings of close to 35%, while the pump performance was improved by modifying the hole geometry to enhance flow dynamics, with the result being a 10%-to-20% fuel economy improvement.

Keystone Powdered Metal Co., St. Marys, Pennsylvania, took home a Grand Prize in the Automotive—Transmission Category for a planetary carrier assembly (Figure 2) made for its customer Ford Motor Company. The 32-part carrier assembly is used in the HF35 hybrid transmission that goes into Lincoln MKZ, Ford C-Max, and Ford Fusion hybrid vehicles. The spider and carrier plate are compacted and then sinter-brazed together before being joined to the shaft. The helical pinion gears are sinter-forged to full density using tools that must also rotate and exactly match the gears’ 24.5 degree angle; it is the first time such a gear has been used in an automotive transmission application. It is estimated the customer realised cost savings on the order of 25% by going this route. In over two years of production of this carrier, with...
about a quarter of a million assemblies shipped, there have been no field returns.

Capstan, Wrentham, Massachusetts, received the Grand Prize in the Lawn & Garden/Off-Highway Category for copper-steel parts made for General Transmission. The parts (Figure 3) make up a disengagement mechanism of an intuitive differential snow-blower system that allows the user to pivot the unit in place by disengaging one of the wheels. These two parts combine for 11 pressing levels, requiring precisely timed tool motions at ejection, along with sophisticated robotics, for crack-free removal from the lower punches. Despite their tremendous shape complexity, these parts are formed to net shape, and specially developed sintering fixtures ensure that flatness and level-to-level relationships are maintained. As a new technology in this product category, this intuitive differential is expected to set the standard for tight-turning requirements for machines of this type.

FloMet LLC, an ARCMIM Company, DeLand, Florida, earned the Grand Prize in the Medical/Dental Category for two 5 millimetre tines—one fixed, one moving—that go into a thermal tissue fusion and dissection system made by its customer ConMed. The system utilises direct thermal energy and pressure to effectively seal, transect, dissect, and coagulate tissue. Fabricated via MIM from 17-4 PH stainless steel, the tines (Figure 4) overcome many moulding and processing challenges, including the fixed tine’s length and thin-rib requirements, as well as the need for straightness over its entire length for full functionality with mating components. Highly innovative tooling and advanced thermal processing techniques were employed to produce two components in a final as-assembled condition with only minimal secondary operations being needed. The fabricator’s expertise in maximising MIM’s advantages was persuasive in having the customer redesign the product to make MIM the preferred manufacturing method.

A three-piece assembly (Figure 5) made by FloMet LLC, an ARCMIM Company, DeLand, Florida, for Shure Incorporated won the Grand Prize in the Electronic/Electrical Components Category. The parts—nozzle interface, outer nozzle, and metal collar—go into high-end sound-isolating earphones that enable user-customisable frequency responses. Made via MIM from 316L stainless steel, the components achieved the objective of producing final net-shape parts that not only met the cost demands of the highly competitive professional-audio market but maintained a cosmetically perfect surface so critical in a consumer product with a clear exterior. MIM was the ideal choice, as alternative fabrication methods, such as die-casting or machining, could not
have provided the precision needed at a reasonable cost, nor been able to provide the required material performance.

Awards of Distinction
Cloyes Gear & Products, Inc., Paris, Arkansas, won the Award of Distinction in the Automotive—Transmission Category for a ball ramp actuator comprising a sector gear and fixed ring, made for Magna Powertrain. The actuator applies torque to the front wheels in the BMW high-performance X-Drive transfer case that goes into various BMW platforms. Warm-compacted from a hybrid low-alloy steel, the parts replaced forged steel components used in an earlier transfer case design, and provided 35% cost savings over the forgings. The fabricator delivers in excess of 700,000 actuators annually through this global program.

Indo-US MIM Tec Pvt. Ltd., Bangalore, India, won the Award of Distinction in the Automotive—Chassis Category for a spur gear made for Magna Closures, Canada. The gear is used in the rear-door assembly of SUVs to enable their opening in the event of loss of automatic control function. Made via MIM from 4605 low-alloy steel, the part replaced a gear that was machined and had the pin welded on, achieving estimated savings of 30% in the process. This gear is an outstanding example of MIM’s ability to meet close tolerances on concentricity and perpendicularity on a part with such a lengthy gear profile. The fabricator delivers 720,000 parts annually.

Lovejoy Powder Metal Group, Downers Grove, Illinois, earned the Award of Distinction in the Lawn & Garden/Off-Highway Category for a parking/emergency brake piston for hydraulic transmissions used in zero-turn-radius lawn maintenance equipment. Made from FC-0208 iron-copper steel, the piston is compacted with three features on top and six on the bottom, using two upper and three lower punches plus a die shelf. The part is an original design for PM, as its shape makes it impractical for traditional metal-cutting methods. It is pressed and sintered to net shape, requiring no secondary machining operations.

Indo-US MIM Tec Pvt. Ltd., Bangalore, India, received the Award of Distinction in the Hardware/Appliances Category for three parts—output shaft, lever, and cover—that are assembled into the quick-change mechanism of a Dremel multitool. The mechanism allows for the swapping of any tool bit within seconds. Made via MIM from 4605 low-alloy steel, the three parts—designed specifically for MIM—are made close to net shape, with only a few secondary operations performed to achieve close tolerances. The highly complex geometry of the shaft, with three holes intercrossing at 120 degrees, required six side cores per moulding cavity.

Figure 4: Grand prize, Medical/Dental category - MIM tines for thermal tissue fusion and dissection system. (Photo courtesy MPIF)

Figure 5: Grand prize, Electronic/Electrical Components category - MIM parts for high-end sound-isolating earphones. (Photo courtesy MPIF)
A sinter-hardened steel retainer weight made by Hitachi Chemical Co., Ltd., Chiba, Japan, won an Award of Distinction in the Hand Tools/Recreation Category. The part operates in the transmission of large motorcycles, controlling the on/off position of the clutch. The challenge of attaining dimensional accuracy in a component with such a thin, large-diameter shape was overcome with process optimisation and the choice of steam treatment. This redesign of a previous PM part achieved a 17% weight reduction. The fabricator anticipates this accomplishment could open the door to additional opportunities in the small- to medium-size motorcycle market.

“An outstanding example of MIM’s ability to meet close tolerances on concentricity and perpendicularity”

Advanced Forming Technology, an ARCMIM Company, Longmont, Colorado, earned an Award of Distinction in the Hand Tools/Recreation Category for a lock hood for a muzzle-loading rifle made for its customer Smith and Wesson. Fabricated via MIM from 4605 low-alloy steel, the hood’s complex geometry presents a challenge for maintaining the large U-shape sufficiently undistorted so that it can be coined into final tolerance. This is accomplished using a unique sintering and staging approach that utilises an ‘active’ setter made of a feedstock having a similar shrink rate to the hood. The MIM process allowed the customer to offer the rifle at the desired price point in this competitive market.

Another Award of Distinction in the Hand Tools/Recreation Category was given to MPP Ridgway, Pennsylvania, for this bathtub drain tool made for ezXtractor. The tool is an assembly of five PM parts—two drain wings, drain top, drain bottom, and drain shaft—all made from FN-0405 modified nickel steel. The innovative design maximises the benefits of PM technology while simplifying complexity for easy assembly with two circlips and two dowel pins. The two integral cams on the shaft create the action that forces the grippers into the pipe ID. The parts are produced to net shape with two machined grooves for the circlips being the only secondary operations needed.

Smith Metal Products, Center City, Minnesota, won an Award of Distinction in the Medical/Dental Category for a MIM 17-4 PH stainless steel shaft assembly used in a novel surgical instrument for passing suture through difficult-to-reach tissue. Unlike most surgical tools, this instrument is single-use, so a precise fabrication process had to be developed that could be scaled up to deliver high volumes at low cost. The process involves moulding the 7 inch shaft in two parts, laser welding them together, and then performing finish machining, ID reaming, heat treating, sand blasting, and passivation to achieve the tight-tolerance dimensions. Still, this method was 4-5 times less expensive than Swiss CNC machining would have been.

Indo-US MIM Tec Pvt. Ltd., Bangalore, India, also won an Award of Distinction in the Medical/Dental Category for a sound tube used in a hearing aid made by its customer Phonak, Germany. The part’s function is to enhance sound frequency and improve hearing. Fabricated via MIM from 316 stainless steel, the highly complex part achieves all its features in the as-sintered condition, with only glass bead blasting for a better finish performed as a secondary operation. An original design for MIM, it is estimated the part provides 20% cost savings over competing forming processes. The fabricator delivers 500,000 parts annually.