PowderMet 2013

Design Excellence Awards Demonstrate New PM Technologies

Winning parts in the 2013 Powder Metallurgy (PM) Design Excellence Awards competition aptly demonstrate that the technology is not resting on its laurels. While capitalizing on PM's traditional strengths—net-shape capabilities that contribute to lean operations, energy and materials savings that enable more sustainable manufacturing, and significant economic advantages that have always been a hallmark—these exemplary components, fabricated via both conventional PM and metal injection molding (MIM), signal a push into new territories.

2013 grand prize winners include raptor jaws (foreground), sensing element, port & ring, and tool holder assembly (first row), compressor clutch, U-bracket & stop, and motor core stator (second row) and transmission rotor (back row).

Grand Prize Awards

Indo-US MIM Tec Pvt. Ltd. from Bangalore, India, earned a grand prize in the automotive—engine category for a sensing element, a threaded port, and a support ring made for Sensata Technologies Holland B.V. from Almelo, the Netherlands. Fabricated via MIM, these components are used in a sensor kit that measures the inlet pressure of the air-fuel mixture in each cylinder of a passenger car engine. The length of the threaded port creates complexity, as do the thin walls and fragile features, and the stringent customer requirements on visual aspects add to the difficulty of fabrication. This new application is estimated to save the customer 50% over the cost of fabrication using alternate technologies.

AMES S.A. from Barcelona, Spain, was awarded a grand prize in the automotive—chassis category for a compressor clutch that is part of an assembly in a braking system for heavy trucks and buses. The system stops the compressor once the necessary air pressure is reached, which saves energy and helps reduce the vehicle's fuel consumption by seven percent. Made of a diffusion-alloyed steel, the complex part is compacted on a CNC 400 mt press at a pressure of >87,000 psi to achieve a required density >7.0 g/cm^3 in any point of the part. Other properties include 66,000 psi yield strength, 103,000 psi ultimate tensile strength, 1% elongation, and 85 HRB hardness. PM was the only technology capable of producing this part at the customer's cost target.

Capstan Tennessee Inc. of Rockwood, Tennessee, was given the grand prize in the lawn & garden/off-highway category for a transmission rotor made for Caterpillar Inc. of Peoria, Illinois. The rotor mates with a magnetic sensor that reads the rotating teeth to generate speed data used for controlling the shift point of transmissions powering large off-highway construction vehicles. Made of carbon steel, this single-level part is pressed to a density of 6.85 g/cm^3, sintered, and then re-pressed to 7.00 g/cm^3.

Claw pole motor core stators made by Burgess-Norton Mfg. Co. of Geneva, Illinois, won the grand prize in the hardware/appliances category. The parts are used to generate a magnetic flux that interacts with a rotor and permanent magnets to produce torque in a high-efficiency brushless DC motor in an electric ceiling fan. Both halves of the motor core are produced using one set of tools: heated fixed-fill shelf die, core rod, single upper punch, and six thin-walled lower fill punches. Formed from a high-compressibility inorganically insulated iron powder, the parts are compacted with pressures exceeding 67 tsi to a density range of 7.4–7.5 g/cm^3, typical ultimate tensile strength of 7,000 psi, and 19,000 psi transverse

rupture strength. The parts are compacted to net shape and require no secondary operations. They belong to a new generation of DC motors using soft magnetic composite PM materials to enable greater design freedom for designers of electric machines.

Indo-US MIM Tec Pvt. Ltd.of Bangalore, India, received the grand prize in the hand tools/recreation category for a tool holder assembly made for Scintilla AG of Solothurn, Switzerland. The assembly that incorporates these two MIM parts—a tool holder and a grip-spring tensioning part—goes into a woodworking tool for fine-detail carving. Part complexity made MIM the obvious fabrication choice: no other technology could produce the part as an integral unit and deliver it in the needed volumes at the target cost. Made of a low-alloy steel, the parts are supplied in the heat-treated condition. Properties include 7.5 g/cm^3 minimum density, 225,000 psi ultimate tensile strength, and 200,000 psi yield strength. To overcome the possibility of distortion on the unsupported open end, the design provided supporting ribs. The grip support ring was produced per print with the help of one turning operation. The MIM design contributes to a lean operation for the customer by substantially reducing lead time through the elimination of many processing steps.

Polymer Technologies Inc. of Clifton, New Jersey, earned the grand prize in the aerospace/military category for two MIM parts—U-bracket and stop—used in a Feedbox Support Improvement Kit (FSIK) for an M249 squad automatic weapon (SAW) used by the U.S. Military. The device is designed to hold various-size high-volume magazine ammunition packs securely to the gun. It extends the service life of the weapon by enabling the soldier to repair it in the field, thus avoiding the cost to taxpayers of a new weapon, which can be as high as $3,200. Drop testing of the firearm with the device attached proved the integrity of the FSIK even while other components were damaged. The innovative I-beam and webbing design allowed the parts to meet the 32–38 HRC hardness range requirement and still maintain the total weight of the kit below 3.5 oz. Molded from MIM-17-4 PH stainless steel, the parts have >7.5 g/cm^3 density, 130,000 psi ultimate tensile strength, 106,000 psi yield strength, and 6% elongation. The only secondary processing of these near-net shaped parts are a coining operation to the bracket in order to achieve the tolerance required for the distance between the notch and the through-hole, as well as tapping the hole to provide necessary threading. Both parts are black oxided to remove their reflective properties, a critical consideration for the safety of the soldier.

FloMet LLC/A QMT Company of Deland, Florida, was awarded the grand prize in the medical/dental category for a 17-4 PH stainless steel jaw made for US Endoscopy, Mentor, Ohio, and used in a Raptor grasping device. Made via MIM, the jaws merge into one design the features of both a "rat tooth" jaw and an "alligator" jaw, combining the functions of a grasper and a retrieval forceps that surgeons use to retrieve foreign objects in the body during minimally invasive procedures. The component design is enormously complex due to its small size, thin-wall requirements 0.25 mm (0.010 in.), and features required to achieve full functionality with the sharp talons and teeth at net shape. The parts have >7.5 g/cm^3 density, 130,000 psi ultimate tensile strength, 106,000 psi yield strength, 6% elongation, and 27 HRB hardness.

Additionally, awards of distinction were given to companies including Indo-US MIM Tec, GKN Sinter Metals, Burgess-Norton Mfg., ASCO Sintering, FMS Corporation, Parmatech Corp., FMS Corp. and Polymer Technology Inc.

The awards were presented during PowderMet 2013 in Chicago, Illinois June 24–27. **PTE**

2013 award of distinction winners include shuttle (first row), actuator and fuel control gear segment (second row), star shifter, hub adaptor and rack and pinion (third row) and rear cam cap and ramp plate (back row).

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