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Welcome to the EPMA Awards 2007

The EPMA has organised its annual prestigious Awards for Excellence in Powder Metallurgy to coincide with the Euro PM2007 International Conference here in Toulouse. The following categories will be presented in the plenary session:

- Components
- Materials & Equipment
- International

In all cases, a panel of independent experts drawn from across Europe, using the following criteria, refereed the entries:

- To what extent is the PM component/material/process described in the entry expected to provide cost savings and/or improved quality?

- To what extent is the entry expected to stimulate further usage of PM technology in the area of applications covered?

- How well is the entry prepared (description of component/material/equipment etc., inclusion of diagrams, photographs and other illustrations)?

- How do you rate this application in terms of excellence in exploiting PM OR How do you rate this application in terms of novelty: surpassing borders of bringing new ideas into practice

With each component, the judges will decide upon a winning entry, which receives the Award of Merit. Also, if any components are worthy of specific praise, then these will be Highly Commended.

This booklet contains details of all the entries for this years competition, which will be on display on the PM Showcase at Euro PM2007.

In addition, as part of our recognition at our International event of the work of companies in other regions, we have also included in this booklet the MPIF 2007 Innovation Awards and the JPMA Awards 2006.

The EPMA wishes to congratulate and thank all its member companies who entered the competition.

Further information on this year’s award entries can also be found on the EPMA website - www.epma.com/awards2007, which will be available late 2007.
Lagerbuchse

Summary: The part is assembled in V6-FSI engines of Audi, for A-6 and A-8 models. The part is making 3 functions in the engine: 1. Driving the vacuum pump. 2. Giving signal to camshaft sensor, in order to measure the camshaft speed and position. 3. Bearing for camshaft. By means of the ability of Powder Metallurgy for generating complicated shapes, the customer could integrate the 3 functions in one unique part, by designing directly to PM.

Company Information: AMES S.A.
Laureà Miró, 388, 08980 Sant Feliu de Llobregat (Barcelona) SPAIN
Phone: 0034 93 685 5111 / Fax: 0034 93 685 4488
Website: www.ames.es

Planetary Assembly

Summary: The part is supporting the planetary gears used in the transfer case of 4WD vehicles. In any of the 6 holes, a shaft is fitted, where planetary gears are turning. The part only works when the short speeds are connected. In any other case, the part is turning free with any work. So the part is acting as a speed reduction of the transmission shaft. This part is assembled in the transmissions of the Volkswagen Touareg, and the Porsche Cayenne. Looking at the shape of the part and the dimensional accuracy, the PM technology is offering the customer many economical savings. The design is so compact, so space is saved. Another advantage of the PM part is the possibility to join parts during sintering. In this case, a sinterbrazing technique is used to join the front and the rear, during sintering, so a joining step is saved.

Company Information: AMES S.A.
Laureà Miró, 388, 08980 Sant Feliu de Llobregat (Barcelona) SPAIN
Phone: 0034 93 685 5111 / Fax: 0034 93 685 4488
Website: www.ames.es

MIM guitar tuner

Summary: Fulfilling the very challenging requirements of the customer, an automatic tuner for electric guitars has been developed and produced by maxon motor. This device helps guitarists to keep their guitar perfectly tuned. The MIM guitar tuner reduces the retuning time of a guitar to 1.5 seconds. An experienced technician would take 30 seconds. The guitar tuner shows in an extraordinary way the possibility of MIM to exactly produce tiny parts. Complex shapes can be economically produced by investing only once in a single mould, giving a short ‘pay back’ time.

Company Information: Maxon Motor
Unter Ziel 1, DE-79350 Sexau, Germany
Phone: 0049 7641 9114 152 / Fax: 0049 7641 9114 666
Website: www.maxonmotor.com
**Gearset for Bush Cutter**

**Summary:** The gear set is made of two components, the gear and pinion. The pinion gear was particularly challenging as the tooth density is crucial to fulfill the customer requirements. The customer undertakes Gearhead assembly tests for strength and endurance, the two gears are the most critical components. MG miniGears has successfully introduced Powder Metal parts in a well-known assembly providing increased durability.

**Company Information:** MG MiniGears  
35127 Padova, via Lussemburgo, 25/27 - Italy  
Phone: 0039 049 8700430 / Fax: 0039 049 761538  
Website: www.minigears.com

**Double bulge diamond bead**

**Summary:** The fabrication of the beads for diamond wires for stone cutting is commonly performed by means of hot pressing, both uniaxially and isostatically, but more and more often by means of the press-and-sinter route. In the former processes the densification of the powders is aided by a pressure applied by a graphite ram or by an inert gas; on the contrary, in the press-and-sinter process densification occurs at low pressure (or vacuum) only because of the effect of temperature. In all cases a preforming of the green bead by means of uniaxial cold pressing is required. A totally new system based on Metal Injection Moulding (MIM) technology has been developed and patented, and a trade mark has been deposited. A new diamond bead with a double bulge profile as been fabricated and tried on a full scale test.

**Company Information:** MIMItalia  
Via alla Costa 24/a, 17047 Vado Ligure, Savona, Italy  
Phone: 0039 019 2100 089 / Fax: 0039 019 2161 574  
Website: www.mimitalia.com

**The Guide block**

**Summary:** This highly stressed sintered part serves to control valve stroke in order to reduce consumption and simultaneously increase performance. The dynamic stress placed on the guide block, with a point load (Hertzian stress) of 1,000 MPa, coupled with the required high degree of precision of the functional radii presented a challenge. The guide block offers many advantages for the customer. For one thing, it can be produced less expensively out-of-tool and for another, further mechanical treatment can be done less expensively through green machining.

**Company Information:** Schunk Sintermetallictechnik GmbH  
Rodheimer Strasse 59, 35452 Heuchelheim, Germany  
Phone: 0049 641/608 1942 / Fax: 0049 641/608 1826  
Website: www.schunk-group.com
**Transfer case Sliding sleeve**

**Summary:** This part is used in a transfer case on 4WD SUV’s. It combines two main functions: the upper part is a sliding sleeve similar to what could be found in a standard manual transmission and the lower part a ring gear as in an automatic transmission planetary assembly. This part was traditionally made out of 2 wrought steel forged parts (sliding sleeve and ring gear), with the sleeve press fitted on the ring gear then welded onto it.

**Company Information:** Sintertech SAS  
Les iles cordées, 38113 Veurey-Voroize  
**Phone:** 0033 6 85 72 68 83 / **Fax:** 0033 4 76 53 79 97  
**Website:** www.federalmogul.com

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**P/M Sliding Sleeve**

**Summary:** The P/M sliding sleeve is designed for a synchronizing unit for a 5 speed manual transmission gear box for a light truck with a torque up to 300 Nm. Capability for all requested dimensions is guaranteed by the material and process.

**Company Information:** PMG Füssen GmbH  
Hiebelerstr. 4, D-87629 Füssen  
**Phone:** 0049 8362 506 179 / **Fax:** 0049 8362 506 6179  
**Website:** www.pmgsinter.com

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**MIM Cold Plate**

**Summary:** This MIM copper cold plate design leverages on the full benefits of MIM process. It has shape complexity capability that gives the designer the maximum flexibility in design concept such as the intricate oval shaped pin geometry of high aspect ratio to provide the optimal thermal performance. The sheer number of small pins, at 279, to be packed within a small confined space, maximizes the overall surface area and hence optimizes the thermal efficiency. In this aspect, it provides the thermal performance of the MIM cold plate an added competitive edge and differentiator over the competitive design of other manufacturing processes.

**Company Information:** Acelent Technologies  
207 Woodlands Ave 9, #06-55, Woodlands Spectrum 2 Singapore 738958  
**Phone:** 0065 6755 0778 / **Fax:** 0065 6755 0776  
**Website:** www.acelent-tech.com
AncorMax 200

Summary: AncorMax 200, introduced in Jan 2006, is a specially formulated lubricant-binder system that allows density of 7.5gm/cm³ to 7.58gm/cm³ to be achieved at conventional sintering temperature with minimal capital investment. This product is applicable to all ferrous material systems. Opens opportunity for powder metal in billion dollar automotive gearing, sprockets, parking brakes etc.

Company Information: Hoeganaes Corporation
1001 Taylors Lane, Cinnaminson, NJ 08077, USA
Phone: 001 856 829 2220
Website: www.hoeganaes.com

Powder Press TPA - HS

Summary: This is the first generation of CNC multiplaten powder presses without die set, offering utmost flexibility combined with the highest possible precision. The new TPA - HS press series provides the following benefits:
- Significant reduction of set up times and thus minimized press downtime
- Setting and adjusting of the tool one time only
- Product quality identical from product run to product run
- Tool interchange between presses without program adoption
- Nearly 100 % press capacity utilization
- Option of side compacting and cross hole pressing
- Economically feasible production of short runs

Company Information: DORST Technologies
Mittenwalder Straße 61, D-82431 Kochel am See
Phone: 0049 8851 188 469 / Fax: 0049 8851 188 270
Website: www.dorst.de

Vancron 40

Summary: The development of the new PM tool steel is based on Materials Design using advanced thermodynamic computer calculation (Thermo Calc) methodology. It was envisaged, based on previous experiences, that a martensitic tool steel with a high amount of dispersed, hard carbonitrides, primarily vanadium carbonitrides should have the demanded material and functional properties. It was then possible to calculate the steel composition, which should give the requested amount and composition of the different phases and of the martensitic matrix.

Company Information: Uddeholm Tooling AB
SE-683 85 HAGFORS, Sweden
Phone: 0046 563 17000 / Fax: 0046 563 17451
Website: www.uddeholm.com
The EPMA Awards for Excellence in Powder Metallurgy are seen as the PM Industry’s most prestigious awards.

Get your entries in early for 2008!
MPIF Awards

Pump Rotor
Category: Industrial Motors/Controls & Hydraulics
Summary: The award was given to a complicated five-level rotor. The rotor functions as part of an assembly in hydraulic pumps that draw petroleum fuels from an in-ground tank to the above-ground nozzle. The part has nine legs, each 50 mm long and 10 mm wide, creating a five-to-one aspect ratio. The legs are pressed to a density of 7.1 g/cm³. Made from MPIF F-0005-25 PM material, the rotor has a tensile strength of 33,000 psi, a yield strength of 27,550 psi, and a 56 HRB hardness. The fabricator performs some machining on the hub and cup. The customer estimates a 30 percent cost savings versus the machined casting used previously.

Company Information: Lovejoy Sintered Solutions LLC
2655 Wisconsin Ave. Downers Grove, IL 60564
Phone: 001 630 852 0500 / Fax: 001 800 446 0878
Website: www.lovejoy-inc.com

Clutch Hub
Category: Automotive-Transmission
Summary: The award was given to a high-precision PM steel clutch hub made using a special low-cost lean-alloy material to meet strict dimensional-control, compressibility, and durability requirements in a demanding-performance environment. The complex six-level part operates in the clutching system of an active four-wheel drive transfer case in light trucks and SUVs. The clutching system replaces a manual synchronizer system to allow full-time active control of torque transfer. It facilitates variable torque distribution to the vehicle's front wheels on the fly. High-temperature sintering provides impressive properties: a minimum density of 7.0 g/cm³, 165,000 psi tensile strength, yield strength of 150,000 psi, and an apparent hardness of 35 HRC. The complex castellated geometry required innovative tooling to precisely control lengths, diameters, densities, weight, and run-out, as well as an even density distribution throughout the part. Annual production exceeds 600,000 parts.

Company Information: Stackpole Automotive Gear Division
2430 Royal Windsor Dr. Mississauga, ON, L5J 1K7
Phone: 001 905 822 6015 / Fax: 001 905 822 9556
Website: www.stackpole.on.ca

Lever Block
Category: Industrial Motors/Controls & Hydraulics
Summary: The award was given to a PM aluminum lever block. The part is used in a quick-change vacuum cup system that handles parts and/or materials. Made to a density of 2.45 g/cm³, the multi-level shape has a tensile strength of 16,000 psi and yield strength of 7,000 psi.

Company Information: Webster-Hoff Corporation
704 E Fullerton Avenue, Glendale Heights, Illinois, 60139-2998, USA
Phone: 001 630 858 8030 / Fax: 001 630 858 4993
Website: www.webster-hoff.com
Orthodontic System Bracket, Slide, and Hook

**Category:** Medical/Dental

**Summary:** The award was given to three parts—bracket, slide, and removable drop-in hook—used in the Damon 3MX self-ligation orthodontic tooth-positioning system. One bracket and one slide go on each tooth with the hook an option for about five percent of the teeth. The very tiny, intricate parts are made by metal injection molding from 17-4 PH stainless steel powder to a density of 7.5 g/cm³. They have impressive physical properties: a tensile strength of 172,000 psi and yield strength of 158,000 psi. All of the parts are made to a net shape. The customer tumble polishes them and performs a brazing operation before assembly.

**Company Information:** Flomet LLC
810 Flightline Boulevard, DeLand, FL 32724, USA
Phone: 001 386 736 4890
Web: www.flomet.com

Fire Hydrant Secure Cap Cover

**Category:** Hardware/Appliances

**Summary:** The award was given to a 316L stainless steel secure cap cover that is used with two other PM parts in a fire protection locking system. The complex part features large external tabs that are precisely oriented to an internal depressed wave form that allows it to mesh with two other PM parts. Made to a density of 6.5 g/cm³, the cap cover has a 20,000 psi yield strength, a 55 HRB hardness, and an as-sintered elongation exceeding 20 percent. The customer subjects the part to a rigorous impact-and-abuse test to prove its integrity against vandals. The three external lugs must withstand the impact of a 10-pound sledge hammer and a torque loading of more than 500 pounds. The main body must be resistant to drilling. The customer realized cost savings of more than 80 percent by choosing PM over conventional machining.

**Company Information:** Metal Powder Products-Anaheim
5500 E. La Palma Ave., Anaheim, CA 92807
Phone: 001 800 767 9706 or 714 970 500 / Fax: 001 714 777 4649
Website: www.metalpowderproducts.com

Trigger Guard

**Category:** Hand Tool/Recreation

**Summary:** The award was given to a trigger guard, made by metal injection molding, that supports the trigger group and hammer in the “quick detachable trigger” mechanism in a 50 caliber muzzle-loading hunting rifle. Made to a density of 7.4 g/cm³, the 3.1 ounce MIM steel part has an as-sintered tensile strength of 94,250 psi and a 58,000 psi yield strength. The part is held to critical dimensions of ±0.005 inches. Secondary operations include: reaming three holes, tapping two screw holes, and deburring. The customer applies the black oxide surface finish and drills one hole because of a design change. Choosing the MIM process provided substantial cost savings.

**Company Information:** Megamet Solid Metals Inc.
4073 Wedgeway Ct, Earth City, MO, 63045-1213
Phone: 001 314 739 4499 / Fax: 001 314 739 5281
Website: www.megamet.com
Dipole Cryomagnet End Cover

Category: Other
Summary: The award was given to an end cover is used in the Large Hadron Collider, the world's largest and highest energy sub-atomic particle accelerator. Made from 316LN stainless steel powder, the part is hot isostatically pressed to full density. The superconducting dipole cryomagnets operate in a cryogenic environment at minus 450°F. As HIPed to a near-net shape of 253.5 pounds, the finished end cover weighs 153.3 pounds. The fabricator incorporated finite element analysis, computer aided design, numerically controlled sheet metal cutting technology, and cutting-edge robotic welding and part manipulation to produce the end covers. This resulted in a more-than-50-times increase over the typical production rate of fully-dense HIPed PM near-net shapes, an unprecedented breakthrough in productivity. About 2,700 end covers have been delivered to CERN. The design of the part features several complex configurations. For example, both the inner and outer surface of the broad face is radiused with the inner surface approximately parallel to the outer surface. The exterior of the curved surface has either eight or 10 projections, depending upon which version of the part is produced. The design differs slightly depending on which side of the dipole magnet it is located. The PM HIPed part meets the equivalent mechanical properties of 316LN wrought stainless steel, including internal toughness and high ductility.

Company Information: Bodycote HIP-Surahammar
Brukgatan, Box 209, SE-735 23 Surahammar
Phone: 0046 220 348 00 / Fax: 0046 220 331 18
Website: www.bodycote.se

Forward-Reverse Actuator Assembly

Category: Lawn & Garden/Off-Highway
Summary: The award was given to an assembly of six net-shape precision PM parts that make up the forward-reverse actuator assembly in golf cart transmissions. By changing the electrical switch, the assembly actuates the transmission linkage to engage either forward or reverse gearing. The parts are made to a typical density of 6.9 g/cm³. Most of the parts require heat-treated properties of 120,000 psi tensile strength, 110,000 psi minimum yield strength, 43,000 psi fatigue strength, and a typical hardness of 35 HRC. While no machining is performed on the parts, secondary operations include zinc plating and vacuum oil impregnation. The customer estimates that PM delivered a 50 percent cost savings over the next most competitive fabrication process.

Company Information: FMS Corporation
8635 Harriet Avenue South, Minneapolis, Minnesota 55420 - 2786
Phone: 001 952 888 7976 / Fax: 001 952 888 7978
Website: www.fmscorporation.com
Camshaft Pulley

Category: **Hand Tool/Recreation**
Summary: The award was given to a stainless steel camshaft pulley that operates in the timing control mechanism for a 4-stroke 115-horsepower outboard motor. With an outer diameter of 4.36 inches, it is considered large for PM stainless steel. It is made to a density of 6.7 g/cm³ and has a tensile strength of 49,300 psi and yield strength of 21,750 psi. Successfully producing the large pulley required a special powder-mixing technique of first coating the particles with a liquid binder, followed by the addition of a substantial amount of a special lubricant. These additives were completely removed by precisely controlled vacuum dewaxing. Machining the inner diameter counter bore is the only secondary operation.

Company Information: **PMG Holding, S.A.**  
101, Route de Holzem, L-8232 Mamer, Luxembourg  
**Website:** www.pmgsinter.com

Handcuff Parts

Category: **Hardware/Appliances**
Summary: The award was given to PM and MIM parts used in tactical hinge-style handcuffs. The handcuffs use 14 PM parts, of which five are different designs—a lock pawl, bow, side and center links, and main links. Twelve parts are made from three stainless steel materials and two parts are made from MPIF FD-0405-60 steel. The four main links are made by metal injection molding to a minimum density of 7.5 g/cm³ and have a tensile strength of 78,000 psi. The other parts are processed by conventional or high-temperature sintering. The bow has a tensile strength of 103,000 psi, and has a large 0.090 inch radius in the areas where it touches the wearer’s wrist. These radii had been machined in the previous design. Three modified 316 stainless steel parts and two duplex stainless steel MIM parts make up the linkage assembly. A proprietary and patent-pending design allows the assembly to be swaged together without using rivets. The stainless steel parts meet stringent government corrosion resistance requirements.

Company Information: **SSI Technologies, Inc.**  
P.O. Box 5011, 2643 West Court St., Janesville, WI 53547-5011  
**Phone:** 001 888 47 4320 / **Fax:** 001 608 758 2491  
**Website:** www.ssitechnologies.com

Differential Carrier Gear

Category: **Hardware/Appliances**
Summary: The award was given to a new differential carrier gear used in a transmission for the Ariens professional Snothro line of 8.5 horsepower-and-higher snow blowers. The new design improved the drive torque output of the unit by speeding up the pinion and increasing the ratio after the friction disc in the transmission. The gear enables remote locking and unlocking of the differential. Formed as a net shape to a density of 6.8 g/cm³, the complex five-level part has a minimum tensile strength of 75,000 psi, a transverse rupture strength of 130,000 psi, a yield strength of 90,000 psi, and a fatigue limit of 34,000 psi.

Company Information: **NetShape Technologies, Inc.**  
596 West Oak Street, Campbellsburg, IN, 47108, USA  
**Phone:** 001 812 755 4501 / **Fax:** 001 440 248 5807  
**Website:** www.netshapetech.com
**Pin Shroud**

**Category:** Medical/Dental  
**Summary:** The award was given to a 316L stainless steel metal injection molded pin shroud used in the Opus Magnum Knotless Implant device for arthroscopic surgical repair of torn rotator cuffs. The implant device secures a sutured tendon to the shoulder bone. The pin shroud is implanted into a patient and is critical to the functioning of the rotator cuff surgical procedure. Made close to a net shape, the MIM pin has a typical density of 7.85 g/cm³, a tensile strength of 78,000 psi, and a hardness range of 75 to 100 HRB, providing good wear properties. More than 200,000 of the parts are produced annually.

**Company Information:** Kinetics, A Climax Engineered Materials Company  
10085 SW Commerce Circle, Wilsonville, OR 97070, USA  
Phone: 001 503 404-1200 / Fax: 001 503 404 1208  
Website: www.kinetics.com

**Sprocket Assembly**

**Category:** Automotive-Transmission  
**Summary:** The award was given to an assembly of two parts, called the sprocket assembly-drive and sprocket-driven, used in an SUV transfer case. The three-level sprocket has a precision-machined tooth radius, hub diameter, and tapered inside diameter, as well as a precise involute profile to facilitate a smooth chain roll-off in operation. Made from a modified MPIF FL-4405 PM material, the parts feature a density of 7.4 g/cm³, a tensile strength exceeding 200,000 psi, an apparent hardness of 45 HRC, and a microhardness of 60 HRC. The sprockets are carbo-nitrided for tooth-wear resistance.

**Company Information:** Capstan Atlantic  
810 Flightline Boulevard, Wrentham, MA 02093  
Phone: 001 508 384 3100 / Fax: 001 508 384 3196  
Website: www.capstanatlantic.com
Development of the Clutch Parts for Power Sliding Door

Summary: We have developed the clutch parts for new hybrid clutch system of PSD driving unit by powder metallurgy. This product consists of three parts which are clutch-out, clutch-in and clutch-guide. This product required height accuracy, shape, strength, sliding and wear resistance to move correctly as hybrid clutch parts. And these shapes were also so complex that it was difficult to produce by powder metallurgy. But we considered them with customers again and again and we’ve completed the suitable shapes for powder metallurgy.

Company Information: Porite Corporation
331-0823 Nissincho 2-121 Kitaku, Saitama City, Saitama
Phone: 0081 048 653 2222 / Fax: 0081 048 660 1292
Website: www.porite.co.jp

Sintered part for AT part with taper shape in inside Diameter

Summary: This part is used in an important functional portion of automatic transmission that makes a shift change smooth to parking condition and that supports its situation. Conventionally, sheet metal stamping has been mainly adopted. However, application of sintered part has been examined because its taper part precision, strength and hardness are important. Feature of the shape of the part has a large taper in half circle part of inside diameter, from which caused some subjects such as compactability for taper end part, galling at compacting and malfunction of molds movement. For improvement of taper part compactability, a subject at compacting with not only molds configuration modification but also with taper shape change together with afterward machining of taper end part after customer approval has been solved. As a result, application of sintered part with large taper part of inside diameter whose shape is difficult to compact has been succeeded and the part can be applied to sleeve parking lock that is an important safety related part for automatic transmission has been realized.

Company Information: Fine Sinter Co., Ltd.
2-30-11, Minami-Ikebukuro, Toshima-ku, Tokyo, Japan
Website: www.fine-sinter.com

High Strength Clutch Hub

Summary: This clutch hub is used for six-speed manual transmission of automobile under high torque. The forged clutch hub is mainly used for this application because it requires tensile strength of 800MPa minimum. However it was costly due to complicated shape with three side holes for hydraulic pressure circuit and multi steps. In case of P/M clutch hub, the tool set of 4 upper and 5 lower punches is needed for compacting of this shape, however such a tool set is not available as yet, and side hole’s shape couldn’t be changed in order to maintain sufficient oil flow.

Company Information: Sumitomo Electric Sintered Alloy, Ltd.
5-33, Kitahama 4-chome, Chuo-ku, Osaka 541-0041, Japan
Website: www.sei.co.jp
Sintering of a cam for reclining seats

Summary: Both high accuracy and high strength have been required in a cam portion of it in order to push up and lock the opposite side part. Also, high strength against a fracture has been required in a pin portion of it in order to pull up and release the lock. Integrating several parts into one compact has been succeeded by means of split portion of die and device of the compacting method despite that it is difficult to compact a net shaped pin portion due to its solid geometry. For high strength in the cam portion, the sizing process has improved sintered density of the cam portion after padding in the necessary spot of the portion due to difficulty in securing a green density (7.3g/cm³ or more) for cost.

Company Information: Fine Sinter Co., Ltd.
2-30-11, Minami-Ikebukuro, Toshima-ku, Tokyo, Japan
Website: www.fine-sinter.com

High Strength and Machinable Powder Magnetic Core

Summary: This powder magnetic core made by internal lubrication with high mechanical strength and high machinability is applied to stator cores with thin and high-L/D shape. There are two kind of powder cores, one is made by die-wall lubrication with high machinability, high mechanical strength and difficult molding the thin and high-L/D shape. Another is made by internal lubrication with easy molding that shape, low machinability and low strength.

There was no powder core with all good properties, so that the powder core with high machinability, high strength and available of continuous molding had to be developed. In this development, to achieve both high machinability and high strength, we developed binder and lubricant with manufactures together. For the binder, we developed polyimide resin with high strength and high heat resistance by research for many kind of materials. Then, we optimized addition ratio of the resin and applied coupling treatment to the powder, so that we improved strength of the powder core 1.4 times higher.

Company Information: Mitsubishi Materials PMG Corporation
5-1, Otemachi 1-chome, Chiyoda-ku, Tokyo 100-8117 Japan
Phone: 0081-3-5252-5206 / Fax: 0081-3-5252-5272
Website: www.pmgsinter.com

Electromagnetic P/M Stainless Steel

Summary: We developed a electromagnetic P/M stainless steel which does not include any Pb. This material shows good magnetic properties, not only high magnetic flux density but also low core loss, and high airtight ability. As the results, this material is suitable for productions of Fuel Injector Cores of LPG Engine.

Company Information: Hitachi Powdered Metals Co., Ltd.
No.7 Tuas Avenue 5, Singapore 639333, The Republic of Singapore.
Phone: 0081 8861 5633 / Fax: 0081 8861 5635
Website: www.hitachi-pm.co.jp
**Thrust Bearing**

**Summary:** Conventional method like special grinding had been employed to manipulate the side surface porosity. However, several disadvantages like long tack time and metal chips are hard to be removed have made the cost reduction activity difficult. We have tried using ultrasonic welding machine this time, which is not related to P/M industry, to close up the side surface porosity and succeed. The method is to use ultrasonic vibration generating hone to press on bearing side surface, then to apply 20kHz vibration on it to create knocking effect. This method uses no lubricant, with minimum metal chips created and tack time is less than one second as compared to conventional grinding method. To ensure effectiveness of this method, optimum condition set is established and is validated through customer evaluation.

**Company Information:** Hitachi Powdered Metals Co., Ltd.
No.7 Tuas Avenue 5, Singapore 639333, The Republic of Singapore.
**Phone:** 0081 6861 5633 **Fax:** 0081 6861 5635
**Website:** www.hitachi-pm.co.jp

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**Development of Sintered Bearing**

**Summary:** A majority of the bearings used in high-speed polygon scanner motor up to now were air bearings, however, due to their low cost and high manufacturing efficiency, sintered bearings were considered to replace the current air bearing. The required properties are: accuracy of the rotation irrespective of the range of rotation speed and application to high rotational speeds. The clearance was reduced to 2 µm and the contact surface length was adjusted to match the rotational unbalance. With respect to the high-speed rotation, a high wear resistance and low evaporating Ethel based lubricating oil having the added feature of preventing oil from smearing the mirror. From the results it is proved that the sintered bearing can be applied for the high rotation speed range of more than 40,000 [r.p.m.] which was only possible by using hydrostatic bearings up until now.

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**Sintered parts for residence shutter drive motor**

**Summary:** Sintered parts for residence shutter drive motor consist of carrier, cam and internal gear. These products are used being installed in the motor of the micro-computer shutter drive system, which loads the safe function controlling the shutter by the obstacle inspection sensor. Conventionally, considered weather resistance and strength, forged parts treated surface treatment were applied for these parts. For purposes of cost down, application of sintered parts is considered. Sintered parts are demanded wear resistance.

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Wave Motion Gear Reducer Parts for Robots

Summary: The characteristics required of the parts are: a high Young's modulus and low thermal expansion for generating wave motion; and good machinability for mass-production. With this developed alloy, Fe and Si greatly increase Young's modulus and reduce the thermal expansion coefficient so that the modulus and coefficient approach those of steel. Moreover, the diameter of the primary Si crystal is kept at approximately 3 µm through rapid solidification and addition of Fe. The flank wear of cutting tool by the developed alloy is one-quarter that by the conventional aluminum alloy, making it applicable for mass production of the gear parts, which requires high precision cutting. As a result, the alloy can satisfy the low weight requirement of the wave motion gear reducer parts, and is being increasingly used in the growing robotics industry.

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